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EDUCATIONAL EXTENSION  
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# GUIDE LEAFLET

## GEOLOGICAL SCIENCE FIELD TRIP

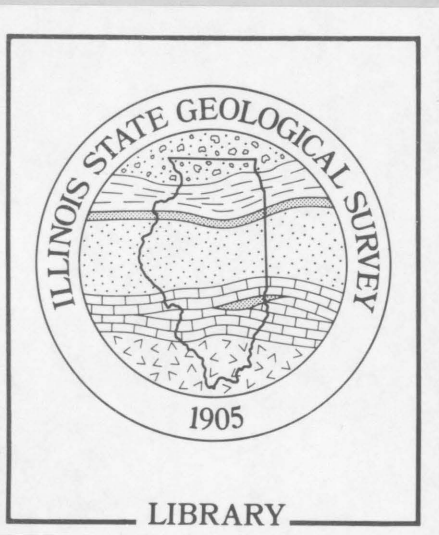
### RED BUD AREA

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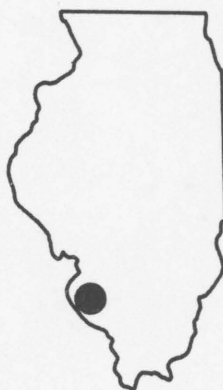
ILLINOIS STATE GEOLOGICAL SURVEY

Urbana 61801



RED BUD AREA

Randolph and Monroe Counties  
Baldwin and Renault 15-Minute Quadrangles



Host—Red Bud High School

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## TO THE PARTICIPANTS:

The Geological Science Field Trip program is designed to acquaint Illinois residents with the landscape, the rock and mineral resources, and the geological processes that have led to their origin. With this program, we hope to stimulate a general interest in the geology of Illinois and a greater appreciation of the state's vast mineral resources and their importance to the over-all economy.

We encourage you to ask the tour leaders any questions that may occur to you during the trip. Discussion often clarifies points that otherwise would remain confused to many of the participants. We also invite your written comments upon the conduct of the trips so that we might improve them as much as possible.

Additional copies of this guide leaflet, as well as itineraries for field trips that have been held in the past, may be obtained free of charge by writing to the Illinois State Geological Survey. The itinerary maps for each field trip can be purchased for 10 cents each.

Several of the stops along this itinerary are located on private property whose owners have graciously given us permission to visit their lands. Please obey the instructions of your trip leaders and conduct yourselves in a manner that will show respect for the property owners' cooperation. Please do not litter, or climb on fences, and leave all gates as found, so that we may be welcome to return on future field trips. These simple rules of courtesy also apply to public property as well. For the convenience of those persons who may use this itinerary at some future time, the names and addresses of every private property owner are listed for the respective stops on a page at the back of this guide leaflet. Whenever possible, always attempt to obtain permission when visiting private property.

We hope that you enjoy today's field trip and will attend others in the future.

THE STAFF  
EDUCATIONAL EXTENSION SECTION  
ILLINOIS STATE GEOLOGICAL SURVEY



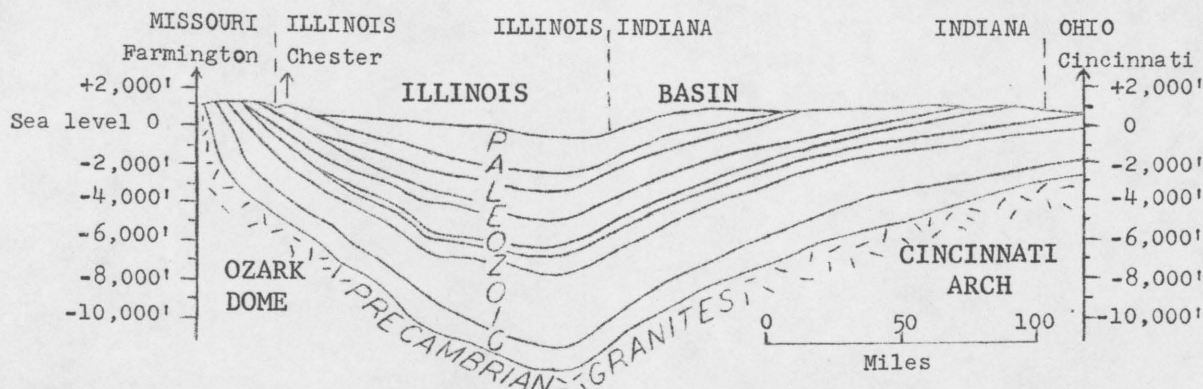
## RED BUD GEOLOGICAL SCIENCE FIELD TRIP

### INTRODUCTION

**Geology** - Exposed at the surface of the Red Bud area are rock strata of the Mississippian and Pennsylvanian Systems (fig. 1) and drift deposits of the Pleistocene Epoch (refer to "Pleistocene Glaciations..." in the appendix and the route map). These sediments and the strata known to exist below the surface are shown in the geologic column (fig. 2).

The Red Bud area lies at the edge of the glaciated part of Illinois and, in fact, contains an unglaciated area, the ridge along the Mississippi River. Glaciers of the Kansan Stage (the second glaciation) may have reached the area, but no definitely Kansan deposits are known. The first advance of the third glaciation, the Illinoian, covered the eastern half of the area with thin deposits of drift as much as a hundred feet thick in places, but averaging perhaps 25 feet. Glaciers of the following Illinoian advances and the much later Wisconsinan glaciation did not reach this far, but their meltwaters carried outwash in the river valleys through the area. Thick outwash from the Wisconsinan glaciers occurs in the Mississippi Valley and was the source of the wind-blown silts that blanket this area and most of the rest of the state bordering the river.

The unconsolidated--"loose," uncemented--sediments are underlain by up to 4,500 feet of much older, sedimentary rocks that were laid down during the Paleozoic Era, the interval of geologic time between 550 and 270 million years ago. This cross section along a line across a four-state region between Farmington, Missouri

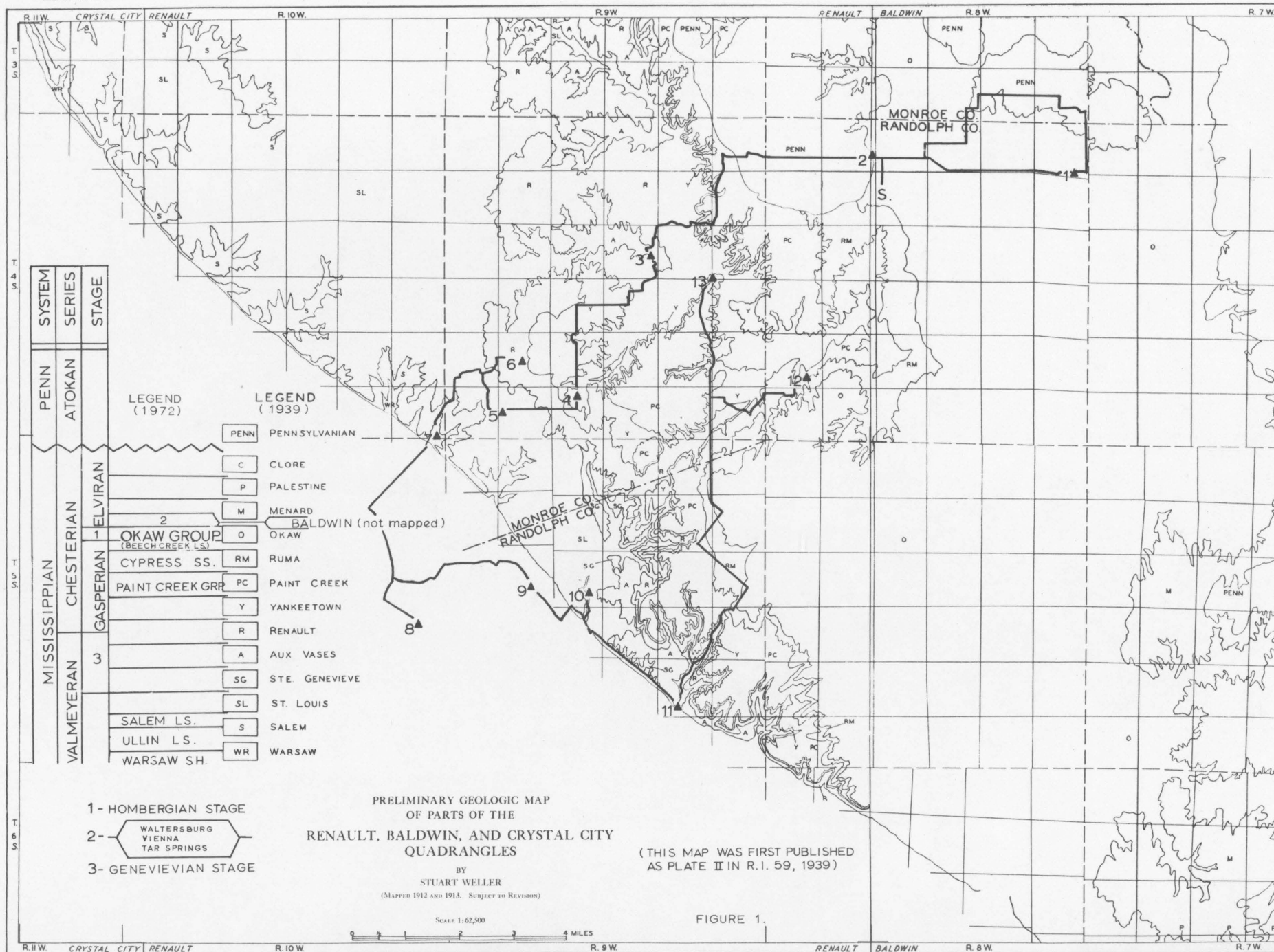


Northeast-southwest cross section of the Paleozoic strata in the Illinois Basin.

(about 30 miles southwest of Red Bud) and Cincinnati, Ohio, shows the thickness and attitude of the rock strata making up the Paleozoic System and the structures--the Ozark Dome, the Illinois Basin, and the Cincinnati Arch--that contain them.

Note: Both the thickness and attitude (apparent dip) of the rock layers are greatly exaggerated by the difference between the horizontal and the vertical scale in the section: an inch on the horizontal scale represents about 37 times the distance represented by an inch on the vertical scale. If, for example, the vertical scale were the same as the horizontal scale, the cross section would look like this--

the same length, but appearing much compressed. It shows thickness relative to length of section and apparent dip accurately but does not provide room to show much else.



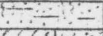

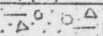

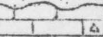
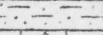
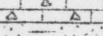
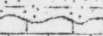
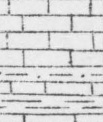

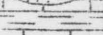
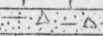
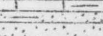

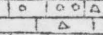
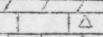
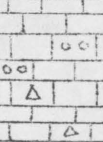
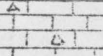
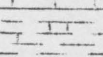
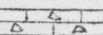
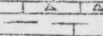
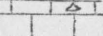
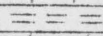
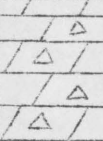
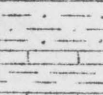
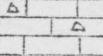
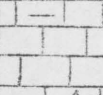
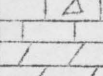

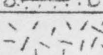
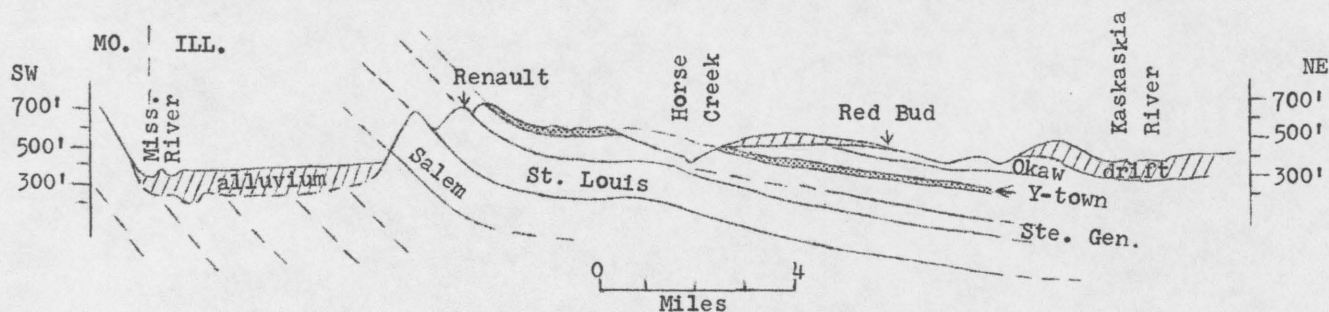
SYSTEM	SERIES	STAGE OR GROUP	FORMATION	ROCK TYPE	THICK-NESS	DESCRIPTION
QUAT.	Pleist.	Holocene				Sand, silt, clay
		Wisconsinan			4-25	Loess, sand and gravel, silt
		Illinoian			0-100	Till, some outwash
PENN.		McCormick Grp.			0-50	Sandstones, siltstones, shales, thin coals, few limestones
MISSISSIPPIAN	Chesterian		Menard		15	Limestone, some chert
			Waltersburg		25	Siltstone, sandy, and shale
			Vienna		5	Limestone, cherty
			Tar Springs		35	Sandstone, siltstone, shale
		Okaw Grp.			200	Limestone, shale, siltstone
			Cypress		55	Sandstone, siltstone, shale
	Valmeyeran	Paint Creek Grp.			40-90	Limestone, variegated shales
			Yankeetown		10-15	Sandstone, shale, chert
			Renault		20-45	Limestone, shale, sandstone
			Aux Vases		50-70	Sandstone
			Ste. Genevieve		55	Limestone, oolitic, and some chert
			St. Louis		80-200	Limestone, some dolomite, some chert
			Salem		250	Limestone, some oolites, some chert
			Ullin		110	Limestone, some chert
			Warsaw		90	Shale, limey
			Burlington-Keokuk		80	Limestone, very cherty
			Fern Glen		100	Limestone, some chert, shale
			Chouteau		0-10	Limestone
					0-15	Shale
		New Albany Grp.			0-200	Dolomite, cherty
ORDOVICIAN	Cinc.	Maquoketa Grp.			100-125	Siltstone, shale, some limestone
	Champlainian	Kimmswick Grp.			95	Limestone, some chert
		Platteville Grp.			490	Limestone, dolomite, some shale, some chert
		Ancell Grp.				
		Older Ordovician and Cambrian strata			2,300	Sandstone, shale, limestone, dolomite
PRECAMBRIAN						Granite, other igneous and metamorphic rocks

Fig. 2 - Generalized geologic column of strata in Red Bud area (not to scale).



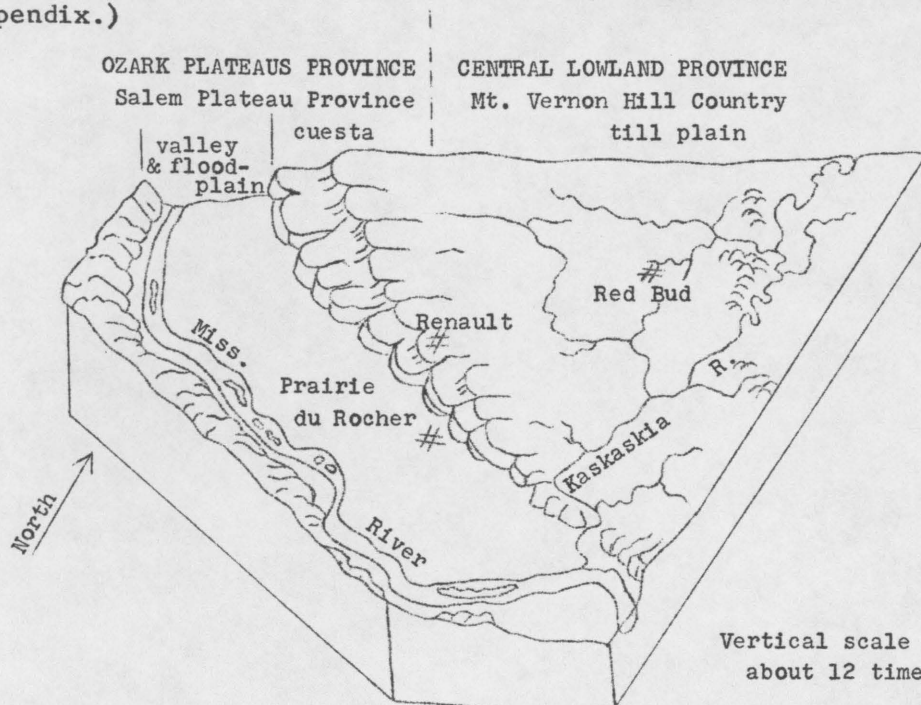
The Precambrian granites shown in the section are 1.2 to 1.5 billion years old. For a long time before the Paleozoic, the granites were exposed above sea level, but at the beginning of the Paleozoic the earth's crust gradually sagged until shallow seas covered the whole region shown by the cross section. Intermittently, slowly, and at different rates, the Illinois Basin sagged and thick layers of sediments accumulated in it. Generally speaking, mud and sand washed from the land into the near-shore parts of seas to make layers of shale and sandstone. Lime oozes and shell materials developing off shore made limestones. The Ozark Dome and the Cincinnati Arch were usually covered by seas also. However, these areas sank more slowly than the basin and at times were even gently warped up, so the Paleozoic strata generally thin toward these structures.

Below is a cross section of the Red Bud area along a line extended through Renault and Red Bud. The beds of the thick, bluff-forming limestones are delineated to show the bedrock dip toward the basin and down off the Ozark Dome. The bedrock surface is shown under the parts of the region covered by alluvium and drift.



Southwest-northeast cross section across Red Bud area.

**Physiography** - The field trip area is the triangular region between the Mississippi and Kaskaskia Rivers, just above their confluence. On the basis of the structure and origin of its surfaces, the area is divided lengthwise into three sections. These are the till plain section, the cuesta section, and the valley section. The block diagram below shows the sections and provides an exaggerated picture of the area's surface. (The names above the section labels refer to the larger physiographic divisions shown on the map "Physiographic Divisions of Illinois" in the appendix.)



Vertical scale exaggerated about 12 times.

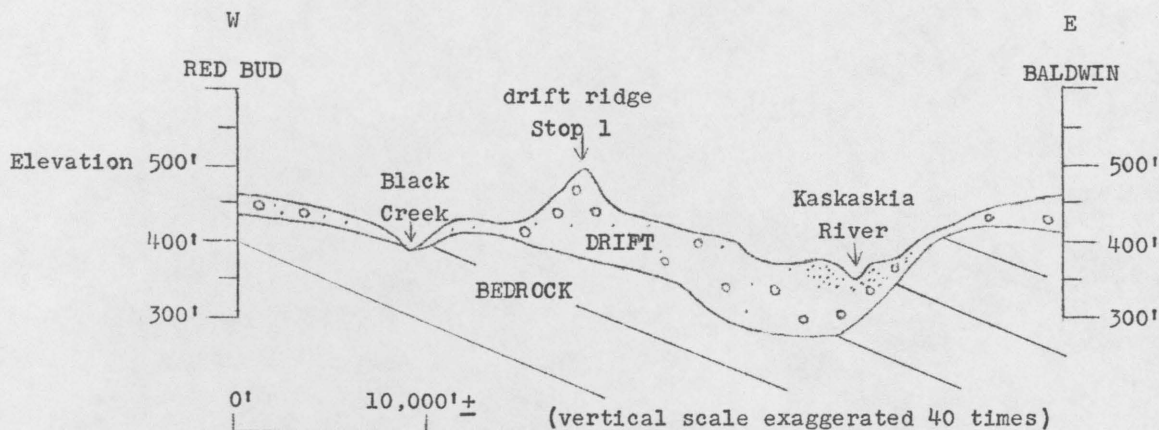


The till plain section of the Red Bud area is the western margin of the Mt. Vernon Hill Country. Its wide shallow valleys and broad uplands were developed when the pre-glacial landscape of low bedrock hills was covered, but not obscured, by deposits of the Illinoian glaciation.

The cuesta and valley sections are part of the Salem Plateau Province. The boundary between the Salem Plateau Province and the Mt. Vernon Hill Country is defined as the Illinoian glacial boundary (see route map). The cuesta is an asymmetrical ridge formed by the outcrop of thick limestone units along the Mississippi River. Drainage off the front (the west side) and backslope of the cuesta have eroded deep valleys across it. Deep weathering of the limestone beds on the cuesta backslope has created extensive sinkhole tracts. The valley section is the modern floodplain of the Mississippi River. The floodplain surface is generally about 150 feet above the bedrock valley bottom--the bedrock valley being filled to nearly the present level by Pleistocene glacial outwash.

#### ITINERARY

- 0.0 0.0 Assemble at parking lot on north side of Red Bud High School. Set odometer to zero. Turn left (north) on Locust Street and go to stop sign.
- 0.5 0.5 STOP. Intersection with Route 3, Market Street. Turn right (east) on Market Street.
- 0.1 0.6 STOP. 4-way stop (South Main Street). Continue straight on Illinois Highway 154.
- 0.5 1.1 Leave Red Bud city limits.



The geological cross section is along a straight line between Red Bud and Baldwin and is nearly parallel to our route to Stop 1. It shows the principal features of the bedrock and present land surfaces, and in a general way shows the dip of rock strata and the thickness of the unconsolidated deposits of glaciers and streams.

Note that the Kaskaskia River flows in valley fill, almost a hundred feet above the floor of its ancestral bedrock valley. The eastern side of the bedrock valley is a low cuesta. The thickest drift in the area is found between the drift ridge and the east side of the river, indicating perhaps several short ice advances across the valley to the ridge. The drift thins westward, up the regional slope.

- 0.75 1.85 Turn left onto blacktop and immediately cross UNGUARDED railroad crossing.
- 0.65 2.5 Cross north-flowing tributary to Black Creek.
- 0.6 3.1 The crest of the drainage divide here is slightly over 440 feet. The ridge straight ahead, and extending from left to right, is a drift ridge deposited by a glacier about a quarter of a million years ago. The elevations of the higher parts of the ridge are slightly more than 500 feet. The glacier moved from the northeast.
- 0.4 3.5 Crossroad. Continue ahead (east).
- 0.4 3.9 Ascend front of Illinoian drift ridge.
- 0.4 4.3 Stop No. 1. Crest of Illinoian drift ridge and exposure (SW $\frac{1}{4}$  SE $\frac{1}{4}$  SE $\frac{1}{4}$  Sec. 1, T. 4 S., R. 8 W., Randolph County, Baldwin 15' quadrangle).

The Rim of the Illinois Basin - The ridge visible on the western horizon, about 12 miles away, is a cuesta that the Mississippi River has cut along the rim of the Illinois Basin. The Paleozoic strata exposed along it are dipping down toward this point, toward the deepest part of the Illinois Basin. The top of the St. Louis Limestone, for example, which is at the surface of the cuesta almost 200 feet above this hilltop, dips until it is about 600 feet below it. In eleven miles the bed dips (slopes down) about 800 feet.

The Baldwin Power Plant and Oil Fields - To the east across the Kaskaskia River, the Illinois Power Company's Baldwin Plant is visible. Coal from nearby mines is used to generate electricity. The plant reservoir covers more than 2,000 acres and also serves as a waterfowl refuge and fishing lake.

Several dozen oil-test wells have been drilled in the near vicinity. In 1954 a field was discovered two miles northeast of Baldwin. Cumulative production from Silurian reef limestone was reported to be about 10,000 barrels by the end of 1970 (300 barrels were produced in 1970 and only one well produced that year). The electric log (or e-log) reproduced in the appendix section titled "The Chesterian Series..." is from a well in this field.

The Marissa West Pool is opposite this stop, just about 3 miles to the east. Discovered in 1962 and abandoned in 1966, it was drilled into the Cypress Sandstone (shown on the e-log in the appendix). Other oil and gas discoveries, some still producing, have been made near Tilden, Sparta, and Coulterville. Although there has been test drilling, there are no producing oil fields in Monroe County.

The Liman Substage of the Illinoian Glaciation - The third of the four Pleistocene glaciations, the Illinoian, began perhaps 250,000 years ago and is believed to have lasted about 50,000 years. During the Illinoian Stage, three different glaciers from the Canadian ice sheet--one after the other--flowed deep into the state from the northeast and then melted back (see the figures with "Pleistocene Glaciations..." in the appendix). The first Illinoian advance, the Liman, covered about 90 percent of the state and flowed farther south than any other glacier. It was the Liman glacier that flowed over the Red Bud area and laid down this ridge and the other drift deposits. Because no later glaciers reached the area, it is presumed that the Liman drift lay exposed to weather through the rest of the Illinoian Stage, the interglacial Sangamonian Stage, and the beginning of the glacial Wisconsinan Stage--a period of possibly 68,000 years.



The Wisconsin Loesses - Meltwaters from the early Wisconsin glaciers in northeastern Illinois filled the Mississippi and Illinois River Valleys with outwash sediments. During the winters, when the outwash-covered floodplains were dry, winds from the west blew clay and silt (powdery "sand") up out of the valleys and eastward across the whole state. These light brown, unlayered wind deposits of silt and clay are called loess (pronounced "luss"). Loess beds are thickest along the source valleys, thinning downwind from the valleys. In Monroe County, the loess is as much as 25 feet thick on the Mississippi bluffs and thins eastward to as little as 4 feet along the Kaskaskia River.

The Drift Ridge and Exposure - This ridge of drift is part of a line of ridges extending north and southeast from here in a discontinuous line. In most places these ridges are emplaced on bedrock hills. If it were known that this ridge was deposited along the glacier front, it could be called a moraine. However, it is located in a part of the Illinoian till plain where a number of ridges occur that were deposited in ice-walled channels (within the glacier field) by meltwater streams. (Further discussion of this matter can be found in Illinois Geological Survey Bulletin 94 and Circular 442.) The question is whether the material in the ridge is ice-laid or water-laid. If ice-laid, the ridge is a moraine. If water-laid, it is ridged drift. The phrase "drift ridge" includes both possibilities.

Although the roadcut at this stop is slumped and overgrown, an exposure halfway down the east slope of the ridge in the south ditch shows:

ILLINOIAN STAGE

Glasford Formation

Top at field level

Weathered drift (Sangamon Soil): mottled yellow and rusty brown with black manganese streaks and nodules; may be slightly calcareous near base; contains rounded quartz pebbles and a few large igneous rocks up to 3 inches in length (Sample D)

Base covered . . . . . 4 feet

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X-ray diffraction analysis of less-than-2-micron fraction: Sample D

Counts per second:		Expandable clay minerals	Illite	Kaolinite and chlorite
Calcite	Dolomite			
—	—	44%	33%	23%

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When the drift was newly deposited, it was gray because the iron-bearing minerals in it were gray and not oxidized, or "rusted." The fresh drift had a great deal of limestone ground up in it that would have frothed had dilute hydrochloric acid been dripped on the exposure (now it will hardly fizz). Long exposure to weathering by water and air and the intrusions of living things have altered the drift--leached out the lime and rusted the iron minerals--and made it a soil. It is named the Sangamon Soil because most of its development took place during the long, interglacial Sangamonian Stage, which followed the Illinoian glaciation. In many parts of Illinois this soil zone is buried under younger layers of thick loess and till. Its distinctive color and mineral content make the Sangamon Soil a widely recognized key bed for determining the identity and relative ages of drift layers that may be found above and below it in the same exposures.

X-ray Diffraction Analysis - X-ray diffraction analysis is used to determine the relative amounts of clay and carbonate minerals in a sample. The clay and carbonate composition of glacial materials tells what direction the glacier came from. Glaciers moving into Illinois from the northwest eroded and picked up sediments from bedrock that was relatively high in expandable clay minerals and calcite. Conversely, glaciers advancing from the northeast and east carried tills with relatively high quantities of illite, chlorite, and dolomite. Although Sample D is so weathered that the carbonate minerals are leached and cannot be "counted," the high illite content indicates its eastern origin.

- 0.0    4.3    Leave Stop 1. Continue ahead (east).
- 0.2    4.5    Cross culvert and turn left (north) onto gravel road at T-intersection. The road ascends the backslope of the drift ridge. It is widening out.
- 0.5    5.0    The route starts to traverse an area that shows the typical surface of an older, eroded drift ridge or moraine. The hummocky topography is not the undrained knob-and-kettle surface typical of younger moraines to the north but is an uneven, undulating surface modified by water erosion.
- 0.65   5.65   Y-intersection. Turn left. At the turn, by the large stump, someone has gathered large pieces of stone which may have been carried in by glaciers. Since the fracture faces on the blocks are not rounded out or smoothed much, they probably haven't been transported very far. From this turn westward for about 0.2 mile, the route again is very close to the crest of the drift ridge and affords an excellent view, particularly to the west and southwest.
- 0.45   6.1    Notice the large gray granite boulder in the yard on the right. It is an "erratic"--that is, a large piece of rock that is not native to this area and that has been carried here by a glacier. It is most probably a Canadian rock since rocks of this type are known to be exposed in Canada but no place between here and there.
- 0.1    6.2    T-road. Turn right (north). Just after the turn, the road goes between steep banks. It is likely that the road has "sunk" through the 4 to 6 feet of loess mantle that remains on these hills. The loess washes easily on low slopes (as you will see later, it stands very well in a perpendicular cut), so the first traffic to cut a rut through the original sod along this slope started the loess washing out. Many lanes and roads on the tops of the low hills east of Red Bud are sunken. A road probably "hits bottom" when it is washed down to till or to a clay-enriched zone.
- 0.1    6.3    T-road. Turn left (west) on blacktop. Note on the geologic map that the area that we have been traversing for the last couple of miles is underlain by Pennsylvanian bedrock. However, we have not seen these rocks exposed in ditches or stream banks along the itinerary.
- 0.65   6.95   Crossroads. Continue straight.
- 0.7    7.65   CAUTION. NARROW CULVERT.
- 0.35   8.0    T-road. Turn left (south) on blacktop.



0.65 8.65 CAUTION. Narrow bridge.

Note the many blocks of stone scattered along at about the same elevation in the fields and woods beside the road. These mark the outcrop of a limestone in the Okaw Group--perhaps the same rock we will see at the next stop. The blocks have slumped down from the outcrop. (The limestone is gray, very fossiliferous, and fine- to medium-grained.)

0.2 8.85 Cross area between two small sinkholes on either side of the road. For about 0.15 mile to the south, there are several shallow sinks. A good example is on the right side, and in the woods on the left there are several smaller sinks. The sinkholes and the previously noted limestone blocks along the lower slopes of the hill are evidence that limestone bedrock underlies this immediate area. (The development of sinkholes is discussed at Stop 5.)

1.25 10.1 CAUTION. Unguarded railroad crossing. DO NOT STOP ON TRACKS.

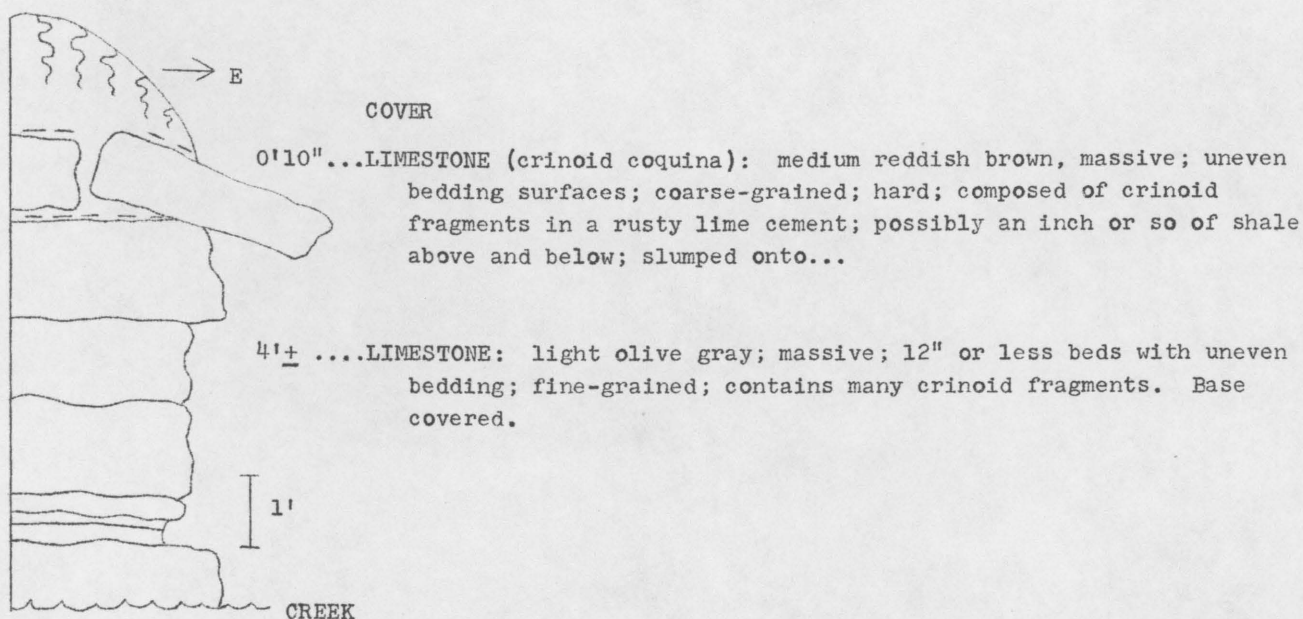
0.05 10.15 STOP. Intersection with Route 154. Turn right (west).

0.25 10.4 Red Bud city limits.

0.5 10.9 4-WAY STOP. Continue straight on Route 3.

0.3 11.2 Turn right on west side of the old cemetery and head north into city park.

0.15 11.35 Stop No. 2. An outcrop of the Beech Creek Limestone in the Red Bud City Park (SE $\frac{1}{4}$  NE $\frac{1}{4}$  SE $\frac{1}{4}$  sec. 5, T. 4 S., R. 8 W., Randolph County, Baldwin 15' quadrangle).



History and Environmental Geology - The outcrop in the west bank of the stream (opposite the old cemetery) was one of the working faces of the Red Bud City Quarry. The quarry excavation is largely filled now, but depressions below street level, which often contain tumbled blocks of limestone, show where the quarry was.

Since the Geological Survey had an analysis of the limestone in 1912 (see Report of Investigations 200), the quarry may have been worked in the first decade of the century. At any rate, it was abandoned long ago and the excavation became the city dump. Finally the dump was made into this park.

The history of this park illustrates a process of land use that occurs in every community on various scales. Whether--for example--limestone, coal, gravel, or fill dirt is wanted, the need for the material and a discovery of a source create a whole complex of possibilities and problems for a community to cope with. The people of Red Bud had 60 to 70 years to respond to the questions this quarry raised about land use, sanitation, public safety, pollution, drainage, and other problems. Their responses, if we could know them, would be of great value to us as citizens of communities who often have not even 6 or 7 years to plan and cope with the same process of discovery, extraction, and re-use.

To students of earth science (ourselves), this place is interesting from two points of view, one traditional and one relatively new. In terms of physical geology, the quarry site provides a place to study the Beech Creek Limestone and determine its composition and dimensions. In terms of environmental geology, it offers occasion to study the use and management of earth materials and the effects these activities had on living things. All sciences are now involved in environmental studies that are undertaken from a perspective different from the traditional physical studies. As a geologist, Dr. John Frye (Environmental Geology Notes 42) explains:

The earth scientist is concerned with the physical framework of the environment wherever it may be, with the supply of raw materials essential to modern civilization, and with the management of the earth's surface so that it will all have maximum utility for its living inhabitants. It is this last item that is a relatively new role for the earth scientist, and one in which he must work cooperatively with the engineer, the biologist, and the social scientist. The earth scientist must become the interpreter of the physical environment, and he must do it in the long-term context of a dynamically changing earth so that "architectural" designs will be in harmony with natural forces 50, 100, or 500 years from now, as well as with the conditions of the moment.

The Beech Creek Limestone - The Beech Creek Limestone is the formation at the base of the Okaw Group of the Chesterian Series. In the appendix, the article "Mississippian Deposition" discusses the regional deposition and the plate "The Chesterian Series..." describes its stratigraphic position.

The 1912 limestone analysis (cited before) noted that 10 feet of limestone was quarried here. (Presumably, the outcrop exposes the upper half of the formation. Data from oil and water well logs and outcrops and quarries indicates that the Beech Creek varies in thickness from 8 to 15 feet in this vicinity. The Beech Creek crops out south of Red Bud along the line on Weller's geologic map (fig. 1) that divides the Cypress ("Ruma") Sandstone from the Okaw Group. There are outcrops nearby on both sides of the highway in the beds of this stream and the next one to the west. It is the youngest unit we see on the field trip.

The Beech Creek Limestone is a thin but remarkably persistent unit. It can be recognized in e-logs across Illinois and in Kentucky, Missouri, and Indiana.



GENERALIZED NORTH-SOUTH CROSS SECTION THROUGH CAVE AND SINKHOLES

It is surprising to find a cave and sinks developing in a sandstone (see the discussion of Stop 5). These features typically occur in dense, jointed limestones, but the cave-forming sandstone bed here readily absorbs water and evidently is not jointed. However, the stone is composed of fine sand cemented by calcite ("lime"). Perhaps water seeping through the bed leaches out the calcite cement and causes the rock to crumble to sand and wash out.

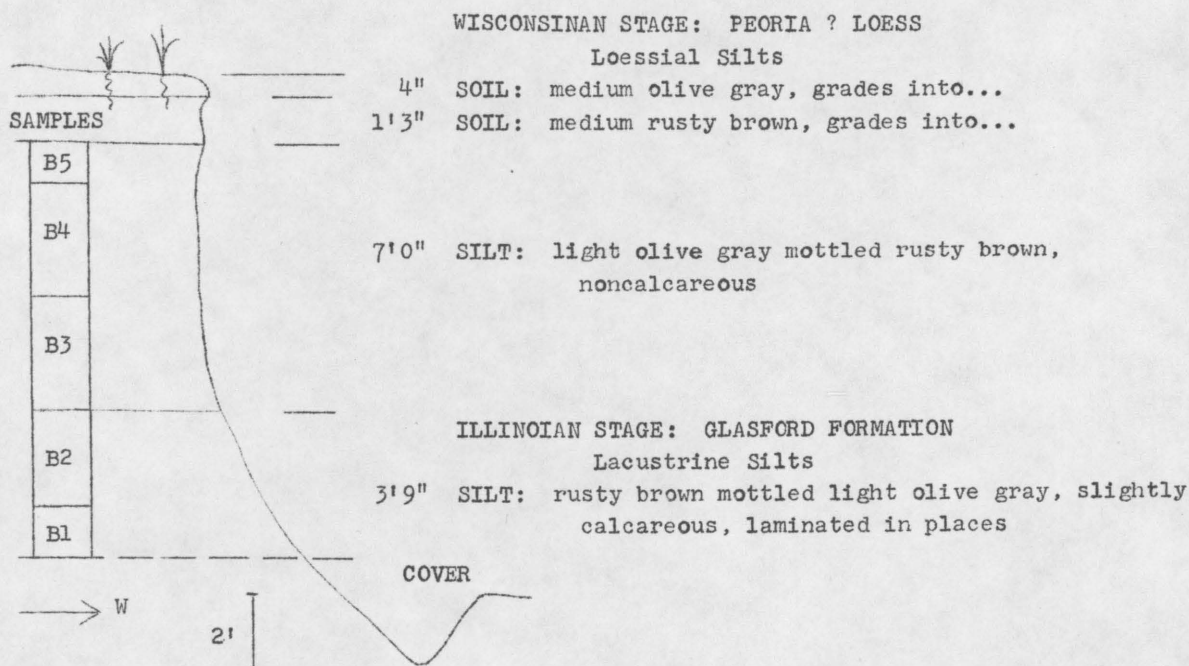
The selective "caving" of the one bed may be explained by the fact that it contains no iron, while the other beds, which are also calcareous, evidently contain iron in addition to calcite as cementing material. The bed in the lip of the falls is not calcareous now--if it ever was--but it is very hard and obviously resists erosion well. Possibly water seeping through this bed has leached out the calcite it contained, but certainly it has dissolved some of the iron in the rock and brought it to the surface, where it has been oxidized and recemented in the outer layer, forming a hard, rusty "case."

The cave and sinks also show how natural bridges are sometimes formed. As the cave and sinks grow larger, sections of the roof over the rivulet running through the cave will collapse, leaving it in an open channel. Parts of the roof will remain, arching over the stream.

- 0.0 17.55 Leave Stop 3. Continue ahead (south).
- 0.3 17.85 Cross old stone arch bridge, one of a number that are still in use in this region. Local stone was used in their construction and the Aux Vases Sandstone was used for many of them. Upstream (west) from the bridge the Aux Vases Sandstone is exposed for about 300 to 400 feet. The upper part contains well developed ripple marks in a gray siltstone. Nearby is an exposure of fossiliferous, argillaceous limestone (belonging to the Mississippian Renault Limestone Formation) about 18 inches thick that is overlain by slumped materials.
- 0.2 18.05 Renault Formation exposed on both sides of road at culvert. To the south (left) are thin-bedded sandstones and siltstones about 2 feet thick. To the right the siltstones are interbedded with thin variegated shales about 5 feet thick.
- 1.1 19.15 Cross draw. To the left (south) of the culvert, the stream bed contains abundant chert rubble weathered from the Yankeetown Sandstone Formation.
- 0.3 19.45 T-road from right. Continue ahead straight.
- 0.5 19.95 T-road from left. Turn left (south).
- 0.6 20.55 T-road intersection. Continue right (west). Stream banks and roadcuts in this vicinity contain much Yankeetown chert rubble.
- 0.05 20.6 T-road from left. Turn left (south) and cross bridge.
- 0.05 20.65 Exposure on the left contains Yankeetown chert rubble overlain by glacial drift. The drift contains a gabbro (dark igneous rock) cobble and other erratics.
- 0.8 21.45 Culvert over a branch of Dry Fork Creek. Thin-bedded and cross-bedded sands of the Renault are exposed downstream (left). A number of glacial erratics were observed in the creek bed.



- 0.05 21.5 At the top of the hill, loess and some silts are exposed in the roadcut.
- 0.2 21.7 CAUTION. Narrow bridge.
- 0.05 21.75 Stop No. 4. Pleistocene silts exposed in cutbank on east side of road, opposite lane entrance (SE $\frac{1}{4}$  NE $\frac{1}{4}$  NW $\frac{1}{4}$  sec. 33, T. 4 S., R. 9 W., Monroe County, Renault 15' quadrangle).



X-ray diffraction analyses of less-than-2-micron fraction: Sample Set B

Sample No.	Counts per second:		Expandable	Illite	Kaolinite
	Calcite	Dolomite	clay minerals		plus chlorite
5	—	—	81%	10%	9%
4	—	—	78%	12%	10%
3	—	—	69%	19%	12%
2	—	?	45%	38%	17%
1	—	38	23%	60%	17%

The silts below the two soil zones look much alike, but inspection of the exposure shows that the Illinoian silt is different from the one above. The lower silt is browner, calcareous, and thinly laminated in places. The laminations--very thin, regular layers of silt and clay--indicate that the lower silt was deposited in a lake a layer at a time.

The X-ray analyses also reveal that the composition of the lower silt is quite unlike that of the upper one (although again weathered samples reduce the sensitivity of the analysis and permit only general conclusions). Sample B2, a lake silt, is much like Sample D, the coarser drift at Stop 1, and presumably they are both Illinoian sediments. In contrast, the upper silt has a Wisconsinan loess composition.

Considering what has been seen so far on the itinerary, it seems likely that the glacial events in the Red Bud area followed this course:

1. The Liman glacier, moving from the northeast during the first substage of the Illinoian, flowed across the ancestral Kaskaskia River Valley and up the backslope of the cuesta.
2. The glacier stopped east of Renault, approximately along the line shown on the route map as the limit of glaciation, before it reached the ridgeline.
3. East and north of Renault, the glacier dammed the valleys of the streams flowing east down the cuesta backslope. (Since Stop 3 we have been crossing these valleys.) Meltwater washed sediment off the glacier and filled the ponded streams with lake deposits of silt and clay.
4. Later, the ice front retreated (the ice melted back) down the cuesta, leaving a thin layer of till over the area it had covered.
5. The ice front probably readvanced to a position from which the drift ridge was deposited.
6. Finally, the Liman glacier stagnated and melted away. Most of the meltwater and normal runoff returned to pre-glacial stream courses because the thin drift deposits did not change the slopes of the pre-glacial valleys or fill the earlier drainage.
7. Outwash from later Illinoian glacial advances and from the Wisconsinan glaciation came down the Mississippi River Valley, and loess blown from them blanketed the region.

0.0 21.75 Leave Stop 4. Continue south.

0.35 22.1 STOP. Intersection. Turn right (west) on blacktop.

0.65 22.75 The upland surface is very hummocky in this immediate vicinity because it lies along the eastern margin of the sinkhole tract. A few shallow sinks are scattered throughout this area. Sinkholes become more numerous and larger to the west. Some have bedrock exposed in their lower portions. A few are filled with water because they have clay plugs in their lower portions.

0.8 23.55 Stop No. 5. Sinkhole topography discussion (Center S edge SW $\frac{1}{4}$  SW $\frac{1}{4}$  NW $\frac{1}{4}$  sec. 32, T. 4 S., R. 9 W., Monroe County, Renault 15' quadrangle).

In this field trip area, the uplands that extend north-northwest from Prairie du Rocher are underlain by the Mississippian St. Louis Limestone Formation, which has a thickness of as much as 200 feet. This tract of land has a tremendous number of irregular to circular depressions called sinkholes. Solution of the St. Louis Limestone and the formation of the sinkholes have produced a surface with a highly pitted to undulating hummocky topography. A number of sinkholes are located in the vicinity of this stop. The sinkhole tract varies in width from less than a mile near Prairie du Rocher to almost 7 miles in the north part of the area (note itinerary map), a distance of nearly 11 miles. This tract continues northward from the field trip area into the Millstadt-Dupo area.



Although there are a few local exceptions, the sinkholes die out eastward as the St. Louis dips beneath the protective cover of younger, shaly formations. The boundary of these formations can almost be mapped by noting the areas devoid of sinkholes. Note that surface streams are almost totally absent within the sinkhole area. Surface water quickly drains down through the sinkholes into the highly fissured, underlying limestones. Some of this water emerges as springs along the bluff to the west.

Terrain characterized by subsurface drainage, caves, sinkholes, and related solutional features is called karst topography. There are four conditions which contribute to the development of karst topography. First, there must be at or near the surface a soluble rock, preferably limestone, and the limestone should be flat-lying or nearly so. Second, one of the most important factors, the limestone should be dense, highly jointed, and preferably thinly bedded. The limestone should not be porous, because if it is the rainwater will be absorbed and move through the whole body of the rock rather than be concentrated along joints and bedding planes. Third, there must be major valleys entrenched below the uplands; these valleys act as outlets toward which the ground water can move in the subsurface. Fourth, there must be ample rainfall.

Although these conditions are fulfilled to varying degrees in the field trip area, many of the other surface and subsurface solution features associated with karst topography are either not developed here or are not known to exist here. Therefore, the term "karst topography" should not be applied to this area. A more appropriate term would be "sinkhole topography." True karst areas such as those in southeastern Missouri, west central Kentucky, and southern Indiana do not exist in Illinois.

Sinkholes form in two ways--by roof collapse of caves near the surface and by solutional enlargement of fissures from the surface downward. In the former case sinkhole formation takes place following uplift and entrenchment of major drainage after an initial period of cavern formation by vadose water (percolating ground water above the zone of saturation, i.e., above the water table). Collapse sinks, known as ponors, are usually deep and steep-walled. In the latter case, large subterranean cavities may not even exist. These sinkholes, called dolines, may form at any time in the karst cycle. Dolines are usually shallow, saucer-shaped depressions whose depth is controlled by the depth of the water table at the time of formation. Both types of sinks are usually present in a sinkhole area. Some of the larger sinkholes in this vicinity are probably collapse sinks, but most are dolines.

Cavern formation in Illinois occurred mainly under vadose conditions late in the Pliocene Epoch, more than 1 million years ago, and early in the Pleistocene Epoch before entrenchment of the Mississippi Valley. During this time dolines were forming by phreatic solution (solution by water under hydrostatic pressure in the zone of saturation, i.e., below the water table) under high water table conditions. Since entrenchment of the Mississippi Valley, the caves and sinkholes have been slowly enlarged by phreatic water. Some collapse sinks have formed. The deposition of glacial drift over the upland in the field trip area has slowed the process, but phreatic solution has continued throughout Pleistocene time and up to the present. Many sinkholes are filled or buried by till and loess.

Depressions of several feet may suddenly develop anywhere in a field when the bottoms of these plugged sinkholes open up. No doubt cultivation has been the cause of some of this. As we continue through the sinkhole area, note that the

depths of the sinkholes do not determine whether they are water-filled or not. Dry, deep sinkholes may be adjacent to shallow, water-filled sinkholes. Thus the water level in the sinks is not influenced by the water table. Rather, it is determined by how tightly they are plugged by drift and clay.

- 0.0 23.55 Leave Stop 5. Continue ahead (west).
- 0.2 23.75 T-road intersection. Turn right (north) toward Renault.
- 0.05 23.8 Loess blankets the upland in this area on either side of the road and is especially noticeable to the right. The loess covers the St. Louis Limestone in this area.
- 0.5 24.3 CAUTION. Enter village of Renault.
- 0.2 24.5 T-road intersection, Turn right (east).
- 1.0 25.5 Stop No. 6. Illinoian-Wisconsinan silts exposed south of road along north-flowing stream (near Center NE $\frac{1}{4}$  NE $\frac{1}{4}$  SW $\frac{1}{4}$  sec. 29, T. 4 S., R. 9 W., Monroe County, Renault 15' quadrangle).

The exposures occur in both banks of the gully for a distance of about 60 yards.

Soil: medium rusty brown . . . . . 2 feet  
 Silt: massive, medium olive gray with rust mottlings and manganese streaks and skins. A few small rounded quartz and angular chert pebbles. Bottom 4 feet faintly calcareous. (Sample C1 is from lower 4 feet; C2 is upper 6 feet.) . . . . . 10 feet

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X-ray diffraction analyses of less-than-2-micron fraction: Sample Set C

Sample No.	Counts per second:		Expandable	Illite	Kaolinite
	Calcite	Dolomite	clay minerals		plus chlorite
2	—	—	66%	18%	12%
1	—	—	66%	21%	13%

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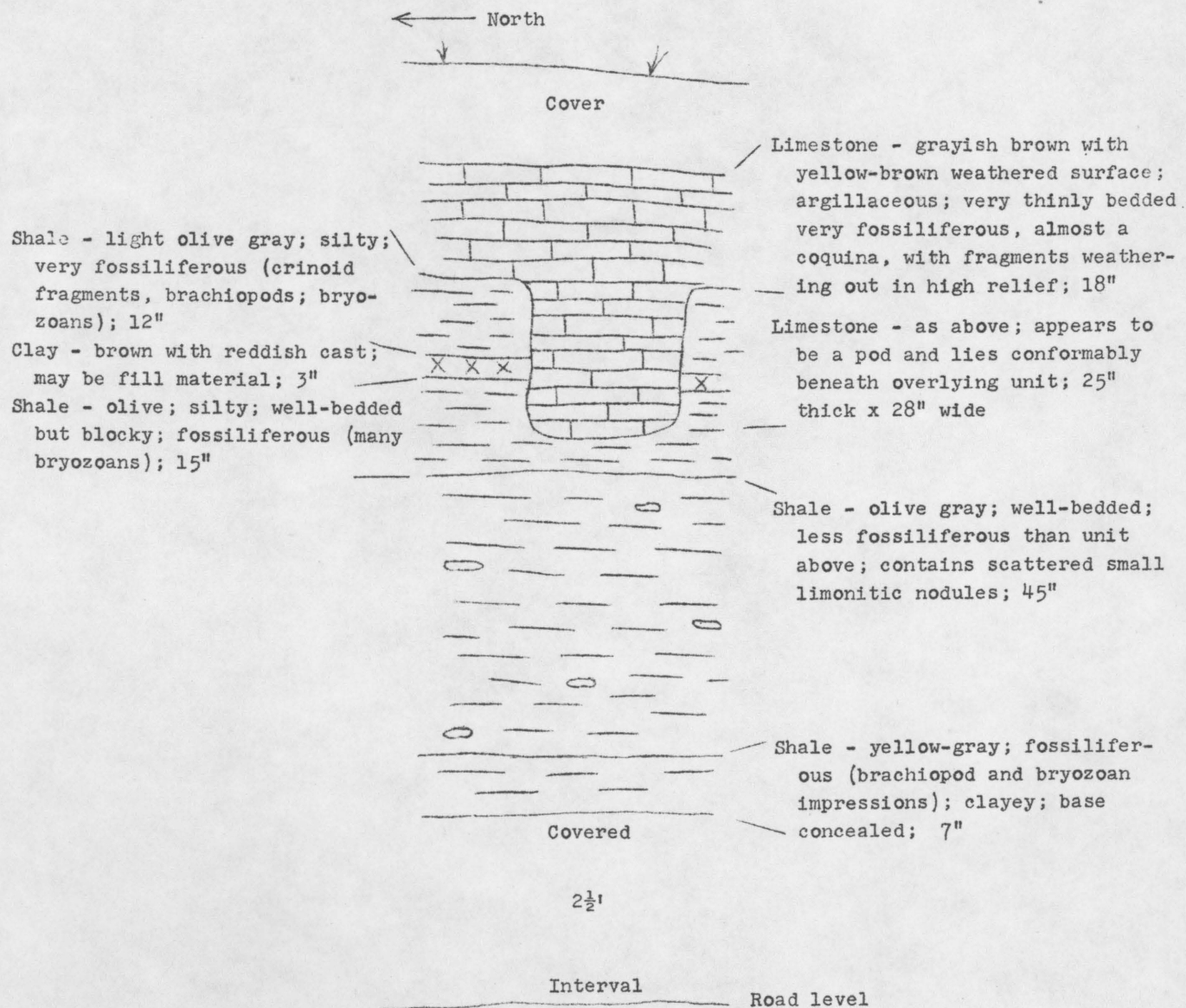
The silts have a loess-like texture and composition. (The analysis of the samples here is much like that of Sample B3 at Stop 4.) However, the small pebbles--which certainly could not have been carried here by the wind--indicate that some of the silt may have been washed into place from loess deposits higher on surrounding slopes. The fact that the exposure is in a low spot strengthens this interpretation.

- 0.0 25.5 Leave Stop 6. Proceed ahead (east).
- 0.05 25.55 CAUTION. Turn around at curve and entrance to farm lane. Retrace route to Renault.
- 1.1 26.65 STOP. Cross street. Turn right (north) and proceed through Renault business area.



- 0.05 26.7 Turn left (west) across from gas station. Road here has been built up so that it divides a large sink.
- 0.15 26.85 Y-intersection. Bear left at sign pointing toward Kidd.
- 0.1 26.95 The pink house on the right side of the road is flanked by two small, water-filled sinks. The one on the east side is very green in color because it supports an algal bloom. The algal bloom appears to be the result of high fertilizing from sanitary discharges on that side. Note the contrast with the sink to the west of the house.
- 0.25 27.2 Bear left and descend hill.
- 0.15 27.35 St. Louis Limestone exposure in ditch to right. From here on down hill, roadside ditches have bedrock exposures in them and the route descends the stratigraphic section, that is, it goes from younger strata at the top downward through progressively older rock units. To the right in the woods, St. Louis Limestone is exposed in a series of small waterfalls, which appear to have formed as the result of small streams cutting back or headward into sinkholes. Thick loess mantles the bedrock on this side of the ridge.
- 0.1 27.45 This point is close to the Salem-St. Louis contact. The Salem here seems to be more thickly bedded than and not as cherty as the overlying St. Louis. Outcrops are more massive. In this area notice the large sinkholes on the left. The drainage disappears underground.
- 0.1 27.55 Notice the vertical faces of loess exposed on both sides of the road here on the curve.
- 0.1 27.65 Exposure of Ullin Limestone is rather shaly and platy.
- 0.05 27.7 On the left side of the road in particular is an exposure of very argillaceous dolomitic limestone that is typical Warsaw. This is near the top of the formation.
- 0.45 28.15 Exposure of argillaceous, fossiliferous limestone and silty shales across from farm.
- 0.25 28.4 Stop No. 7. Exposure in roadcut on left side (east) of road, showing the argillaceous limestone and silty shales of the Warsaw (near Center E edge SW $\frac{1}{4}$  SE $\frac{1}{4}$  SE $\frac{1}{4}$  sec. 36, T. 4 S., R. 10 W., Monroe County, Renault 15' quadrangle).

This exposure illustrates a gradual change in the marine environment from an almost barren muddy bottom (lower shales) to an inhabited muddy carbonate sea bottom (upper shale and limestone). The sea probably was fairly shallow and the water quite muddy so that few life forms could sustain themselves when the lower shales were deposited. The upper shale and limestone strata, however, indicate that the water was deeper and somewhat more clear when they were deposited and thus more diverse forms of life could exist in abundance there. The broken fragments indicate that the bottom was at least occasionally agitated, probably by large waves.



- 0.0 28.4 Leave Stop 7. Continue ahead (south and west) on blacktop.
- 0.25 28.65 STOP. Crossroads. Continue ahead (west) toward Kidd (formerly Boxtown)
- 0.2 28.85 The itinerary descends a low alluvial fan produced by a tributary that flows from the bluff line out onto the Mississippi River floodplain. The gradient (stream-bottom slope) of the tributary lessens rapidly upon entering the broad, nearly flat Mississippi floodplain. The confining walls of the tributary also abruptly disappear at the bluff line and the stream at one time was able to spread out laterally with ease. These two factors caused the tributary water flow to lessen rapidly so that it no longer was able to transport its sediment load as easily as it had farther upstream. Thus it deposited the sediments and the stream channel became filled. This choking of the channel caused the stream to shift from side to side distributing its load over a wide area in a fan shape.



Worthen, in 1873, described the valley here as being part of the "American Bottom," which extends nearly 80 miles along the east side of the Mississippi from Alton southward to the mouth of the Kaskaskia River. The valley here is about 4 to 4.5 miles wide, whereas near St. Louis it is nearly 11 miles wide.

- 0.25 29.1 Cross Fults Creek Ditch.
- 0.4 29.5 CAUTION. Unguarded railroad crossing. Two tracks.
- 0.85 30.35 T-road intersection. Turn left (south). Sign on tree on west side of road across from tavern points south and states "Fort Chartres State Park - 3 Miles."
- 0.25 30.6 Itinerary here is along the edge of alluvial fill that has been scoured by flood water meanders. Note the scars preserved to the right.
- 0.35 30.95 T-road intersection from right. Continue ahead straight.
- 0.15 31.1 Excellent view of bluff line to left.
- 0.15 31.25 Old barn to right has a stone foundation that may have been "quarried" from the ruins of Fort Chartres.
- 0.55 31.8 T-road from left. Continue on blacktop and bear right.
- 1.2 33.0 Entrance to Fort Chartres State Park on right. Enter parking lot and park.

Fort de Chartres (say "Shar' tra") was the seat of civil and military rule in the Illinois Country from 1719 until 1772. The original fort of logs was completed in 1720 by the French some distance to the south but soon was destroyed by flood waters. Although rebuilt in 1727, it lasted only about 5 years because of flooding and poor upkeep. In 1732 the commandant erected another log fort to the north, about  $\frac{1}{2}$  mile north of the present fort. This log fort also fell into such disrepair that in 1747 the garrison was withdrawn to Fort Kaskaskia, about 16 miles to the southeast. Realizing in 1753 that war was imminent, the French constructed the present stone fort over a 3-year period. The area and the fort were ceded by France to England in 1763. English troops assumed control of the fort in 1765 and renamed it Fort Cavendish. The fort then was the seat of English government until 1772, when severe flooding by the Mississippi River caused collapse of parts of the west and southwest walls. The fort then was abandoned and destroyed.

Over the years until 1915, when the State of Illinois purchased the land, the walls and buildings were scavenged by local people for building stone and timbers for their dwellings and barns. The park has been designated a National Historic Site.

NOTE: Dripstone (cave-type deposits) is present on the west and southwest parts of the gate structure. Percolating dripwater from condensation and rain has dissolved some of the cement from between the upper stones in the structure. The dissolved material has been deposited by one or another, or both, of the following processes. Dripwater partially evaporates and becomes saturated with calcium carbonate ( $\text{CaCO}_3$ ), causing the carbonate to be precipitated or left behind as small



stalactites or "cave straws." The other process for dripstone deposition takes place through the loss of carbon dioxide ( $\text{CO}_2$ ) from dripwater. Carbon dioxide is picked up from organic materials and air by water. The  $\text{CO}_2$  increases the ability of the water to dissolve  $\text{CaCO}_3$ . Evaporation and/or a temperature change in the percolating dripwater causes it to lose some of the  $\text{CO}_2$ , thus permitting the deposition of  $\text{CaCO}_3$  along the gate arch and sentry cubicles.

0.1 33.1 Stop No. 8. Lunch. Discussion of the origin of the Mississippi River Valley.

Late in Tertiary time the Mississippi Valley region was reduced by erosion to a surface of low undulating relief that sloped gently southward. This old erosion surface, the Ozark Peneplain, is preserved in the accordant (even-crested) summit heights visible at the horizon on both sides of the Mississippi River. These summit levels coincide with summit levels on the Buzzard's Point plain to the southeast in the Shawnee Hills Section in extreme southeastern Illinois, the Calhoun Peneplain to the north in the Lincoln Hills Section, and the Lancaster Peneplain in the Wisconsin Driftless Section of the Upper Mississippi Valley region.

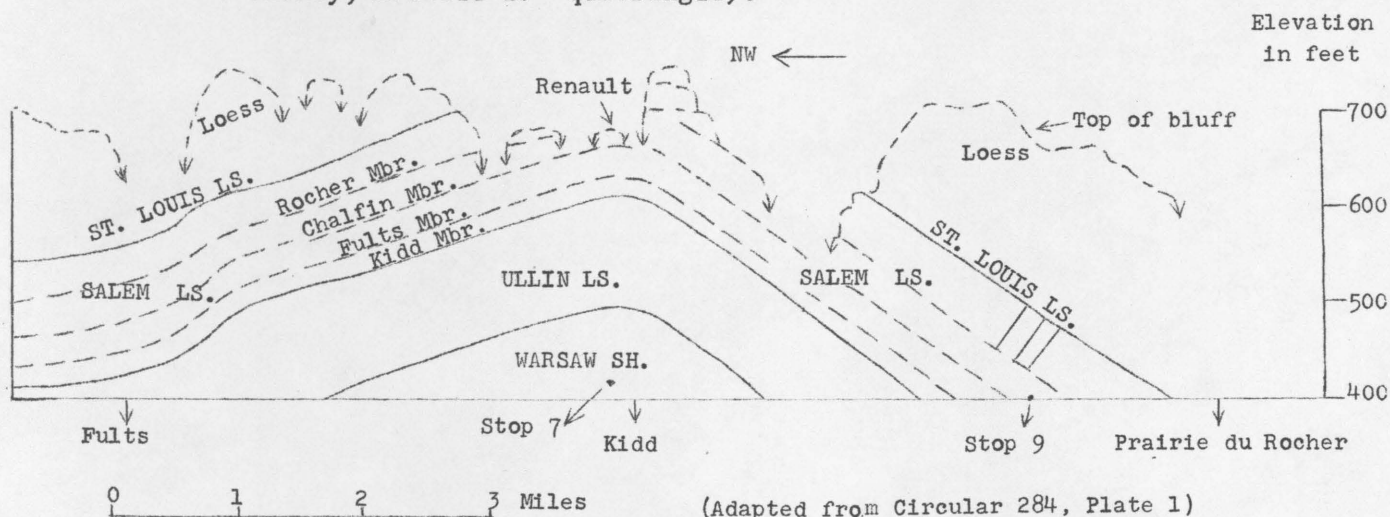
Late in Tertiary time during the Pliocene Epoch, uplift of the Ozark Dome changed the direction of slope on the Ozark Peneplain. The peneplain in this region became slightly tilted to the east, northeast, and north around the uplift. Major drainage flowed northward. Early in Pleistocene time (about 1 million years ago), with the advance of the Nebraskan glacier from the northwest, northward-flowing streams were dammed by the ice and diverted eastward and southward around the margin of the Ozark Dome. The course of the Mississippi River probably originated at this time as meltwaters sought a southward escape route. Entrenchment of the valley occurred during the post-Nebraskan, Aftonian interval and during the early part of the Kansan glaciation. Maximum relief in this region was developed during the early part of Kansan time, when torrential meltwaters eroded the valley to its greatest depth. Widening, filling, and re-excavating of the valley have taken place during and since Illinoian and Wisconsinan glaciations.

A great flood of glacial meltwater poured down the Mississippi Valley during the rapid melting of a large ice mass called the Valparaiso glacier. The Valparaiso glacier represented a major readvance of the late Wisconsinan glacier, just entering extreme northeastern Illinois about 13,000 years ago (number 11 of "Sequence of Glaciations..." diagram in appendix). During melting of the Valparaiso ice 13,000 to 12,000 years ago, conditions were such that drainage from an enormous ice front, formed by ice lobes in the Lake Superior, Lake Michigan, and Saginaw Bay Basins of Wisconsin, Illinois, Michigan, and Indiana, was concentrated into the Illinois and Mississippi Valleys. In the Illinois Valley, into which vast amounts of meltwaters poured from the Kankakee Valley, the resultant flood has been named the Kankakee Flood. There, at the height of the flood, the volume of meltwater was so great that the waters formed several great lakes in lowland areas behind glacial end moraines (number 11, "Sequence of Glaciations..." diagram in appendix). Flood waters that discharged from the large glacial lakes in northeastern Illinois gouged out part of the older valley fillings. The present floodplain is developed on the remainder of these materials and on Holocene sediments, further filling the bedrock valley to a thickness of 100 to 150 feet. The river channel itself is more than 100 feet above the rock floor of the valley (note text diagram on page 4).

0.0 33.1 Leave Stop 8 and parking lot. Prepare to turn left.

0.1 33.2 STOP. Intersection with blacktop road. Turn left (northwest) on blacktop.

- 1.2 34.4 T-road from right. Turn hard right (east).
- 0.7 35.1 Cross culvert.
- 0.6 35.7 Cross drainage ditch (Onemile Race Creek).
- 0.05 35.75 View ahead shows numerous openings into the bluff caused by large underground limestone mines. Also notice the gentle southeastward dip to the bedrock strata.
- 0.35 36.1 Cross drainage ditch.
- 0.55 36.65 CAUTION. Unguarded Missouri Pacific Railroad crossing. Three tracks.
- 0.1 36.75 Just beyond the curve is another good view of the bluff and the mine openings. Also, from the left notice the beds dipping toward the southeast.
- 0.4 37.15 Allied Chemical Mine to left in bluff. The openings in this first mine are in the same stratigraphic horizon as the openings in the mine farther to the southeast.
- 0.2 37.35 CAUTION. Unguarded railroad mine spur.
- 0.25 37.6 Stop No. 9. A view of the cuesta front and the limestone mines (from the intersection of the railroad track and Illinois Highway 155 in Prairie du Rocher, 1.2 miles northwest along the tracks--the stop being on the road just east of the tracks. T. 5 S., R. 9 W., Randolph County, Renault 15' quadrangle).



The rock strata in the bluff are folded up to form a low anticline between Fults and Prairie du Rocher. This slight structure is sufficient to bring the St. Louis from the top of the bluff at Renault to the base of the bluff near Prairie du Rocher, and to bring the Warsaw Shale up from subsurface to the outcrop at Stop 7.

The cross section shows the structure and identities of the bluff-forming beds. If it is compared to the view it represents--the one we are looking at--the



effects of vertical scale exaggeration in cross sections become obvious. (Note, for example, that the three lines drawn in the Rocher Member above "Stop 9" in the diagram represent several of the mine openings opposite the stop and are close to scale.)

The mine entrances go into the Rocher Member of the Salem Limestone Formation. This unit is a commercial source of "high-calcium" limestone because it generally contains less than 5% non-carbonate materials (quartz, silt, chert, clay) and often less than 3%. The Rocher is a bioclastic limestone, i.e., it is largely composed of the shells of marine organisms. A study of the Salem Limestone (Illinois State Geological Survey Circular 284) concluded that the environment of its deposition "was similar to that now existing on the Great Bahama Banks."

Mineral Production in the Red Bud Area - The value of Illinois' mineral production in 1969 amounted to \$692.9 million; this was the 14th consecutive year that it exceeded \$600 million. This was an increase of \$22.3 million, or 3.3 percent, over 1968. Randolph County ranked 11th (\$19.2 million) in total minerals produced, which include coal, stone, crude oil, and common sand. Monroe County, which with two other counties ranked 36th in minerals produced, reported production figures for stone (limestone and dolomite) only.

Stone produced for various purposes during 1969 accounted for slightly more than 18 percent of the state's total value of all minerals produced. Randolph County ranked 6th and Monroe County ranked 39th out of 60 producing counties in the amount of stone quarried.

- 0.0 37.6 Leave Stop 9. Continue ahead.
- 0.1 37.7 The corn crib 0.35 miles east-northeast toward the bluff on the left is across the road from a small tributary stream coming down across the bluff. This stream disappears into a swallow hole (sink) about 3 feet behind the bluff line and drops into a small plunge pool that opens out to the valley at the base of the bluff, thus forming a small natural bridge.
- 1.15 38.85 CAUTION. T-road intersection with blacktop. CONTINUAL TRUCK TRAFFIC. This is the route of heavy trucks coming from the mines loaded with rock. Turn right and head toward Prairie du Rocher. At this point we are just about at the top of the unit (the Rocher Member) that had the mine openings in it.
- 0.2 39.05 St. Louis Limestone exposed on left.
- 0.05 39.1 Cross creek.
- 0.05 39.15 STOP. Intersection with Illinois Route 155. Turn left.
- 0.05 39.2 CAUTION. Cross bridge and turn left again.
- 0.05 39.25 Notice the excellent exposure of loess on the right side of the road.
- 0.2 39.45 Through the trees on the right side of the road notice the St. Louis Limestone exposures.



- 0.2 39.65 Stop No. 10. Abandoned hilltop quarry in the St. Louis Limestone (on the first northbound road to intersect Illinois Highway 155 east of Prairie du Rocher, measure from the intersection 0.45 mile north to the stop. T. 5 S., R. 8 W., Randolph County, Renault 15' quadrangle).

An overgrown lane on the east side of the road ascends the hill to the quarry. The highest face of the quarry exposes 52 feet of St. Louis Limestone. The limestone is light gray, fine-grained, thin-bedded, and cherty. The chert is interbedded with the limestone in innumerable continuous, knotty bands several inches wide. The upper half of the exposure contains more chert than the lower part. The St. Louis Limestone exposed here looks very similar to the St. Louis exposed at Stop 11.

- 0.0 39.65 Leave Stop 10. Turn around and retrace route to Prairie du Rocher.

- 0.25 39.9 Note the large stand of Equisetum ("horse tail" rushes) on the right side toward the creek. This plant is akin to some of the scouring rushes that grew during the Pennsylvanian Period 300 to 270 million years ago.

- 0.2 40.1 STOP. Intersection with Route 155. Turn right (west).

- 0.15 40.25 Turn left (south) on blacktop toward Modoc and the river ferry.

Prairie du Rocher ("Prairie by the Rock") was founded by French settlers in 1722. It is Illinois' oldest town.

- 0.25 40.5 Y-intersection. Bear left. Follow the Modoc blacktop.

- 0.1 40.6 The limestone bluffs along here have many solution cavities in them, and places where small streams have flowed out from joints (enlarged fissures in the rock).

- 0.25 40.85 From this point onward, for a little more than a mile, the geologic map (fig. 1) shows the Ste. Genevieve Limestone cropping out in the top of the bluff and overlying the St. Louis Limestone.

- 0.15 41.0 Leave Prairie du Rocher.

- 0.55 41.55 The notch in the bluff to the left is a gas pipeline crossing. Just to the south of the notch, where some of the rock debris has been loaded out about two-thirds of the way up the bluff, one can see cross-bedding in the limestone just above a very thick massive layer.

- 0.25 41.8 T-road from left. Continue ahead (south) on blacktop.

- 0.1 41.9 About a third of the way up the bluff face, behind the house, is a very thick massive limestone unit that has cross-bedding. Between half and two-thirds of the way up, there is a very red cherty zone, described by Weller as being the lower part of the Ste. Genevieve.

- 0.45 42.35 To the left notice the very sharp change in appearance of the bluff line. Notice the rather uneven, irregular contact between the Aux Vases Sandstone and the underlying St. Louis Limestone along the cliff face, about a third of the way up. Here the Aux Vases is massive with a billowy texture and has a decided rusty cast to it.

- 0.5 42.4 At the Aux Vases and St. Louis-Ste. Genevieve contact, continue ahead south.
- 0.15 42.55 To the left note the cross-bedding in the Aux Vases Sandstone.
- 0.1 42.65 Notice the very blocky, irregular character of the St. Louis and how cherty some of these masses are. They appear almost as if they were detached and recemented.
- 0.05 42.7 T-road from left. Turn left.

Stop No. 11. Cliff on north side of road intersection showing Aux Vases Sandstone overlying the St. Louis Limestone (from the Prairie du Rocher city limits, 1.6 miles southeast along bluff road to intersection with northbound road. Center of the SE $\frac{1}{4}$  SW $\frac{1}{4}$  of projected sec. 26 on Weller's Geologic Map, fig.1, T. 5 S., R. 9 W., Randolph County, Renault 15' quadrangle).

The cliff exposes 15 feet of light gray St. Louis Limestone overlain by about 25 feet of rusty brown, gray-stained Aux Vases Sandstone.

The Missing Ste. Genevieve Limestone - The Ste. (Sainte) Genevieve Limestone, which occurs between the St. Louis and the Aux Vases almost everywhere, is missing here and along much of the St. Louis outcrop in the Red Bud area. (Refer to the geologic column, fig.2, and the e-log in the appendix.) Even the small Ste. Genevieve outcrops shown north and southeast of Prairie du Rocher on the geologic map (fig. 1) may actually be beds of the St. Louis Limestone that resemble the Ste. Genevieve.

There are at least two possible explanations for the absence of the Ste. Genevieve between the St. Louis and the Aux Vases here:

1. The Aux Vases may have been deposited in a channel that cut out the earlier deposited Ste. Genevieve sediments.
2. The Aux Vases sand was being deposited here at the same time that the Ste. Genevieve lime materials were being deposited elsewhere.

To support the first explanation, one would need to find a side of the channel and see the erosional contact between the channel filling and the Ste. Genevieve beds beside the channel. To support the second explanation, one would have to find beds of the Aux Vases and the Ste. Genevieve interfingering.

Lithology - The St. Louis outcrop consists of fine-grained limestone and nodular chert interbedded in thin layers (see also Stop 10).

The Aux Vases is highly cross-bedded and deeply stained by iron oxides. Its thickness in this area ranges from 50 to 70 feet. Because the Aux Vases contains such conspicuous amounts of iron, geologists who worked before 1866 called it the "Ferruginous Sandstone," i.e., the "iron-bearing" sandstone.

Uses of the Aux Vases Sandstone - In this region, the Aux Vases has been a source of building stone, water, and petroleum. A. H. Worthen, the first permanently commissioned state geologist in Illinois, stated in his 1866 report that



the sandstone was "an excellent freestone, can be sawed or cut easily when freshly quarried, and hardens on exposure." Perhaps his judgment is verified by the number of old sandstone road bridges and dwelling foundations still standing.

The Aux Vases is an aquifer. A Red Bud city well (Illinois State Geological Survey County No. 123, located a quarter mile north of Stop 2) penetrates the Aux Vases. The driller reported that the well was finished in 57 feet of "white sandstone" occurring between the depths of 225 feet and 282 feet. Not only water, but oil can fill open pore spaces between the grains in a sedimentary rock, and so the Aux Vases, like other Mississippian sandstones, is a petroleum reservoir outside of the field trip area.

NOTE: The Modoc National Prehistoric Site is located 0.15 miles southeast of this stop, at the base of the bluff along the blacktop road. Archeological excavations have uncovered many Indian artifacts which indicate that here was the earliest known human habitation east of the Mississippi River. Skeletons studied from here were buried between about 6,219 and 2,765 B.C. In 1952 the Illinois State Museum began a detailed program of uncovering and studying this site. For more detailed information, see "Summary Report of the Modoc Rock Shelter," Illinois State Museum R.I. No. 8, and later works.

- 0.0 42.7 Leave Stop 11. Proceed ahead (northeast) on gravel road.
- 0.05 42.75 Loess and silts in the roadcut on the left.
- 1.6 44.35 To the right on the wooded slope is chert float from the weathered Yankeetown Sandstone Formation. Chert float is also exposed to the left, about 75 feet back from the road.
- 0.3 44.65 Considerable numbers of limestone float blocks from the Paint Creek Group, particularly in the ditch and up the slope on the left side of the road.
- 0.45 45.1 Small sinkholes on the right side of the road. Just ahead there are some on the left side. A couple are water-filled. These are comparatively small sinkholes developed in limestone of the Okaw Group. This small group of sinks extends eastward beyond the house. Beyond the house the fairly gentle slopes are draining in towards the center of the sink from the surrounding plowed fields.
- 0.35 45.45 Crossroads. Turn left (northwest).
- 1.25 46.7 STOP. Intersection with Route 155. Turn right (northeast). Just after turning, note on the right how the fields have been contoured to retard erosion on the slope. These fields are along the divide between the drainage basins of the Mississippi and Kaskaskia Rivers.
- 0.7 47.4 SLOW. Prepare to turn left.
- 0.1 47.5 T-road from left. Turn left on blacktop toward Ames.
- 0.4 47.9 To the left notice the small, shallow sinkholes developed in here in an area underlain by limestone of the Paint Creek.
- 0.15 48.05 Note the baby sinkhole on the right.



- 0.25 48.3 View to the left is across the drainage of Pinnt Creek. The type area of the Paint Creek Group is exposed in this vicinity. The road along here affords an interesting panorama of quite a large area south of Red Bud.
- 0.35 48.65 Monroe-Randolph County line. Continue ahead (north).
- 0.05 48.7 Notice considerable amount of loess in roadcut.
- 0.1 48.8 Crossroad. Continue ahead.
- 0.35 49.15 Loess and thin till exposed in roadcut.
- 0.2 49.35 Cross Paint Creek.
- 0.2 49.55 Enter small community of Ames. Continue ahead.
- 0.25 49.8 Crossroads. Turn right (east) on gravel road.
- 0.6 50.4 CAUTION. Narrow bridge (concrete sides over old stone arch).
- 0.4 50.8 Fossiliferous Paint Creek limestone exposed in hog lot on the right side of the road.
- 0.25 51.05 CAUTION. Narrow stone arch bridge.
- 0.15 51.2 T-road from right. Turn right.
- 0.5 51.7 Note the considerable amount of limestone debris in the roadcut on the left.
- 0.1 51.8 T-road. Turn left. Note the considerable amount of limestone rubble in the creek on the right.
- 0.15 51.95 T-road intersection. Turn right.
- 0.15 52.1 To the left in the low roadcut, limestone of the Paint Creek crops out. It is quite fossiliferous in part.
- 0.15 52.25 Stop No. 12. Outcrop of limestones and shales of the Paint Creek Group in the lane entrance (NE $\frac{1}{4}$  SW $\frac{1}{4}$  SE $\frac{1}{4}$  sec. 30, T. 4 S., R. 8 W., Randolph County, Renault 15' quadrangle).

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This outcrop is on private property and permission to visit it must be obtained from the owner, Mrs. Vera Nagel, who lives at the end of the lane.

Please do not dig in the slope. It erodes very easily.

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The units are exposed along the west side of the lane. The red shale at the base of the outcrop is probably the upper part of the Bethel Formation. (See

"Chesterian Series..." in the appendix and fig. 1.) The limestone and shale section above, then, would be part of the Ridenhower Formation. The limestone bed at Stop 13 may be the lowermost formation in the Paint Creek Group, the Downeys Bluff Limestone.

ILLINOIAN STAGE

Glasford Formation

Drift: reddish brown and pebbly . . . . . cover

MISSISSIPPIAN SYSTEM

Chesterian Series

Paint Creek Group

Note: The whole section is calcareous. All shales are plastic when wet.

Shale (weathered zone): yellowish gray interbedded with  
yellowish orange . . . . . 1'8"

Shale with limestone interbeds: gray shale beds 4 to 5  
inches thick interbedded with thin, slabby, gray  
limestones 1 to 8 inches thick; limestones are dense,  
medium-grained, and weather brownish gray; both units  
abundantly fossiliferous (brachiopods, horn corals,  
crinoids, bryozoans, pentremites) . . . . . 8'3"

Shale: light olive brown above and grayish olive  
below. . . . . 1'10"

Shale: dark yellowish orange mottled light olive  
gray . . . . . 1'2"

Note: The shales below do not appear to be fossiliferous.

Shale: light olive gray mottled with dark yellowish  
orange; massive with hackly fracture . . . . . 1'7"

Shale: dusky yellow mottled and interlaminated with  
yellow-green; massive with hackly fracture; some  
zones iron-stained dark yellowish orange, grades  
into . . . . . 1'4"

Shale: dark reddish brown, mottled dark yellowish  
brown toward top; blocky with hackly fracture . . . 1'9"

0.0 52.25 Leave Stop 12. Retrace route to Ames.

0.3 52.55 T-road intersection. Turn left (south).

0.15 52.7 T-road intersection. Turn right (west).

0.6 53.3 T-road intersection. Turn left.

0.15 53.45 CAUTION. Narrow stone arch bridge.

- 0.6 54.05 CAUTION. Narrow stone arch bridge.
- 0.6 54.65 STOP. Crossroad at Ames. Turn right and head north on blacktop.
- 0.6 55.25 The area in here is underlain by the Yanketown Chert and is the type locality of this formation.
- 0.6 55.85 To the right, in the field, a chert rubble band marks a weathered Yankeetown outcrop.
- 0.15 56.0 Crossroads. Continue on the blacktop.
- 0.8 56.8 To the right is another exposure of the Yankeetown chert rubble in the field.
- 0.4 57.2 Stop No. 13. A limestone of the Paint Creek Group showing solutional effects (NW $\frac{1}{4}$  SW $\frac{1}{4}$  SW $\frac{1}{4}$  sec. 13, T. 4 S., R. 9 W., Monroe County, Renault 15' quadrangle).

A bed of gray limestone about 6 feet thick crops out on the east side of the road. It is dense, thinly bedded, and jointed. It is the final illustration, on an itinerary crowded with such illustrations, of a simple fact: Limestones are soluble in water containing carbon dioxide.

Water descending through the unit along bedding planes and joints has widened them and opened them up, rounded every corner, and dished every flat surface--in total, creating the smoothed shapes of corrosion.

End of field trip.

Continue straight ahead to Route 3.



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# APPENDIX

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## PLEISTOCENE GLACIATIONS IN ILLINOIS

Origin of the Glaciers - During the past million years--the time called the Pleistocene Epoch--most of the northern hemisphere above the 50th parallel has been repeatedly covered by glacial ice. Four different times, ice caps formed in sub-arctic regions and spread outward until they became ice sheets that covered northern parts of Europe and North America. In North America the four glaciations, in order of occurrence from the oldest to the youngest, are called the Nebraskan, Kansan, Illinoian, and Wisconsinan Stages. In the following pages the limits and times of the ice movement in the state are illustrated by several figures.

The North American ice sheets developed in parts of eastern and central Canada during periods when the mean annual temperature was perhaps 4° to 7° C. (7° - 13° F.) cooler than it is now and winter snows did not completely melt during the summers. Because the cooler periods lasted tens of thousands of years, thick masses of snow and ice accumulated to form ice caps. As the ice caps thickened, the great weight of the ice and snow piled in them caused their margins to flow outward, often for hundreds of miles. Ice caps and sheets evidently changed the climates of the regions they occupied, and the areas of snow accumulation probably grew as the ice sheets expanded.

Tongues of ice--lobes--grew from the faster spreading margins of the ice sheets and some flowed southward from the Canadian centers around Hudson Bay and converged in the central lowland between the Appalachian and Rocky Mountains. In the lowland, which has since Paleozoic times held the courses of America's largest river systems, the glaciers made their farthest advances to the south. The sketch on the next page shows several centers of flow, the southern extent of glaciation, and the general directions of flow from the centers. Because Illinois lies entirely in the central lowland, it has been invaded by glaciers from every center--from the first glaciation about a million years ago, to the last, a mere 12,500 years ago.

Effects of Glaciation - Pleistocene glaciers and the waters melting from them changed the landscapes they covered. The glaciers scraped and smeared the landforms they overrode, leveling and filling many of the minor valleys and even some of the larger ones. Moving ice carried colossal amounts of rock and earth, for much of what the glaciers wore off the ground was kneaded into the moving ice and carried along, often for hundreds of miles.



The continual floods shed by melting ice trenched new drainageways, deepened old ones, partly refilled both with sediments, and washed great quantities of rock and earth beyond the glacier fronts. According to educated guesses, the amount of water drawn from the sea and changed into ice during a glaciation was probably enough to lower sea level to somewhat more than 300 feet below present level. Consequently, the volume of meltwater available in a continental ice sheet to erode and transport sediment is so great that it is difficult to imagine.

In most of Illinois, then, glaciers and their meltwaters buried the old rock-ribbed, low, hill-and-valley terrain and created the flatter landforms of our prairies. The mantle of soil material and the deposits of gravel, sand, and clay left by the glaciers over about 90 percent of the state have always been of incalculable value to Illinois' residents.

Glacial Deposits - The deposits of earth and rock materials moved by a glacier and deposited as the glacier advances or melts are collectively called drift. Drift that is thought to be ice-laid is called till. Water-laid drift is called outwash. Pleistocene glaciations created many till and outwash forms that can still be recognized.

Ice-laid drift--till--is deposited when earth and rock carried in the bottom of the ice are scraped off and plastered down, or when a glacier melts and the rock and earth it carries slumps to the ground. Because its sediments are not moved much by water, a till is unsorted (contains particles of different sizes and compositions) and unstratified (unlayered). A till may contain materials ranging in size from microscopic clay particles to large boulders. However, tills in Illinois generally occur as pebbly clays.

Tills may be deposited as end moraines, the arc-shaped ridges that pile up along the glacier edges where the flowing ice cannot move the ice front forward --perhaps the ice is melting as fast as it moves forward, or perhaps the front is lodged on a ridge or slope. Till also may be deposited as ground moraines, or till plains, which are gently undulating sheet deposits dropped in place when the ice stagnated. Deposits of till identify places once covered by glaciers. Northeastern Illinois has many alternating broad ridges and level tracts, which are the succession of end moraines and till plains deposited by the Wisconsinan glacier.

Sorted and stratified drift carried into place by water melting from the glacier is called outwash. As a meltwater stream washes the drift sediments along, it sorts them by size--lighter sands and clays are, as a rule, carried farther downstream than heavier gravels and cobbles. Outwashes are bedded or layered because the flow of water depositing them changes. If the flow of water dropping sand in a particular place increases and runs faster, the water can carry heavier sediments farther and, perhaps, deposit gravel on the sand. Typically, Pleistocene outwashes in Illinois are multi-layered beds of clays, silts, sands, and gravels that look much like modern stream deposits.

Outwash deposits are found in the area covered by the ice field and sometimes far beyond it. Because meltwater streams run off the top of the glacier



and in cracks under the ice, outwash features can be found where the glacier lay. In some places, the cobble-gravel-sand filling of the bed of a stream that flowed in the ice is preserved on the till plain as a sinuous ridge called an esker. Cone-shaped mounds of coarse outwash, called kames, are formed where meltwater plunged through crevasses in the ice or into ponds along the edge of the glacier.

The finest outwash sediments, the clays and silts, formed bedded deposits in the ponds and lakes that filled glacier-dammed stream valleys, the sags of the till plains, and some low, moraine-diked till plains. Meltwater streams entering a lake quickly lose speed and almost immediately drop the sands and gravels they carry, forming deltas at the edge of the lake. Very fine sand and silts are moved across the lake bottom by wind-generated currents, and the clays, which are transported in the water the longest, slowly settle out and accumulate with them.

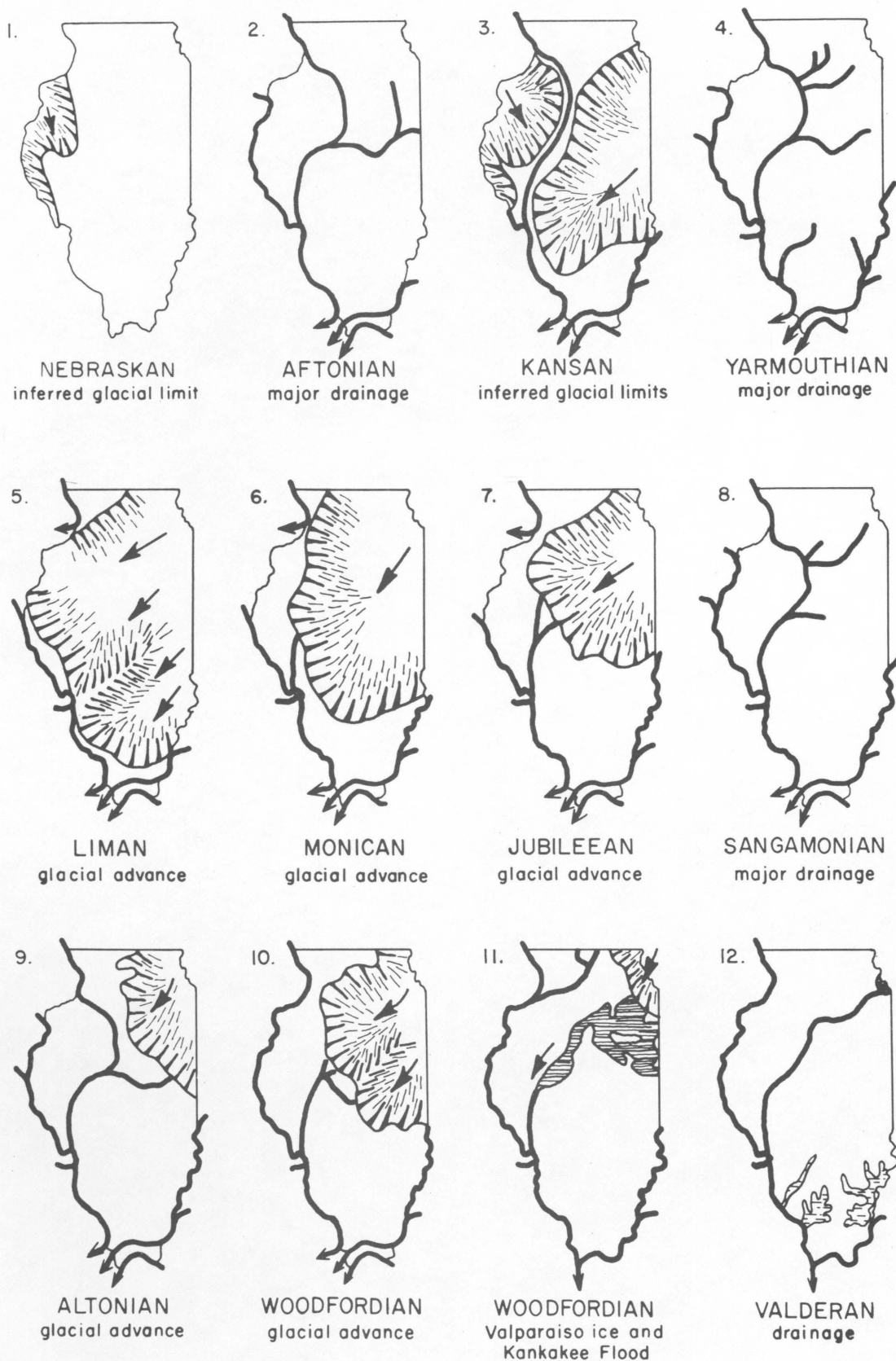
Everywhere along the ice front, meltwater runs off in innumerable shifting and short-lived streams that lay down a broad, flat blanket of outwash that forms an outwash plain. Outwash is also carried away from the glacier in rivers cut by floods of meltwater. The Mississippi, Illinois, and Ohio Rivers were major channels for meltwaters and were greatly widened and deepened during times of the greatest meltwater floods. When the floods waned, these valleys were partly filled with outwash far beyond the ice margins. These outwash deposits, largely sand and gravel, are known as valley trains. Valley trains may be extensive and thick deposits. For instance, the valley train of the Mississippi Valley is more than 200 feet thick along much of its length.

Loess and Soils - One of the most widespread sediments associated with glaciation was carried, not by ice or water, but by wind. Loess, the name given to such deposits of wind-blown silt and clay, covers the surface of most of Illinois. The silt was blown from floodplains of the valley trains. Most loess deposition occurred in the fall and winter seasons, when cold temperatures stopped the thawing and caused meltwater floods to recede, exposing the surfaces of the valley trains and permitting them to dry out. During Pleistocene time, as now, the west winds prevailed, and the loess deposits are thickest on the east sides of the source valleys. The loess thins rapidly away from the valleys.

Each Pleistocene glaciation was followed by an interglacial stage that began when the climate warmed enough to melt the glaciers and their snowfields. During these warmer intervals, when the climate was similar to that of today, drift and loess surfaces were exposed to weather and used by living things. Consequently, over most of the glaciated terrain that was above water, soils developed on the Pleistocene deposits and changes in composition, color, and texture took place in zones beneath their surfaces. Often such soils were destroyed by later glacial advances, but if they survive, they serve as keys to the identity of the covering beds and are evidence of the passage of a long interval of interglacial time. In the glaciated parts of Illinois, the sides of almost every new roadcut and ditch show soil and weathering zones as wide bands in tones of brown, red, yellow, or gray.



# SEQUENCE OF GLACIATIONS AND INTERGLACIAL DRAINAGE IN ILLINOIS



(From Willman and Frye, "Pleistocene Stratigraphy of Illinois," ISGS Bull. 94, fig. 5, 1970.)

# TIME TABLE OF PLEISTOCENE GLACIATION

STAGE	SUBSTAGE	NATURE OF DEPOSITS	SPECIAL FEATURES
HOLOCENE	Years Before Present	Soil, youthful profile of weathering, lake and river deposits, dunes, peat	
WISCONSINAN (4th glacial)	7,000		
	Valderan	Outwash, lake deposits	Outwash along Mississippi Valley
	11,000		
	Twocreekan	Peat and alluvium	Ice withdrawal, erosion
	12,500		
	Woodfordian	Drift, loess, dunes, lake deposits	Glaciation; building of many moraines as far south as Shelbyville; extensive valley trains, outwash plains, and lakes
	20,000		
	Farmdalian	Soil, silt, and peat	Ice withdrawal, weathering, and erosion
SANGAMONIAN (3rd interglacial)	28,000		
	Altonian	Drift, loess	Glaciation in northern Illinois, valley trains along major rivers
ILLINOIAN (3rd glacial)	75,000		
	200,000		
	Jubileean	Drift, loess	Glaciers from northeast at maximum reached Mississippi River and nearly to southern tip of Illinois
	Monican	Drift, loess	
YARMOUTHIAN (2nd interglacial)	Liman	Drift, loess	
	250,000		
KANSAN (2nd glacial)		Soil, mature profile of weathering	
	600,000		
AFTONIAN (1st interglacial)		Drift, loess	Glaciers from northeast and northwest covered much of state
	700,000		
NEBRASKAN (1st glacial)		Soil, mature profile of weathering	
	900,000		
		Drift	Glaciers from northwest invaded western Illinois
	1,000,000		

## MISSISSIPPIAN DEPOSITION

(The following quotation is from Report of Investigations 216: Classification of Genevievian and Chesterian...Rocks of Illinois (1965) by D. H. Swann, pp. 11-16. One figure and short sections of the text are omitted.)

During the Mississippian Period, the Illinois Basin was a slowly subsiding region with a vague north-south structural axis. It was flanked by structurally neutral regions to the east and west, corresponding to the present Cincinnati and Ozark Arches. These neighboring elements contributed insignificant amounts of sediment to the basin. Instead, the basin was filled by locally precipitated carbonate and by mud and sand eroded from highland areas far to the northeast in the eastern part of the Canadian Shield and perhaps the northeastward extension of the Appalachians. This sediment was brought to the Illinois region by a major river system, which it will be convenient to call the Michigan River (fig. 4) because it crossed the present state of Michigan from north to south or northeast to southwest....

The Michigan River delivered much sediment to the Illinois region during early Mississippian time. However, an advance of the sea midway in the Mississippian Period prevented sand and mud from reaching the area during deposition of the St. Louis Limestone. Genevievian time began with the lowering of sea level and the alternating deposition of shallow-water carbonate and clastic units in a pattern that persisted throughout the rest of the Mississippian. About a fourth of the fill of the basin during the late Mississippian was carbonate, another fourth was sand, and the remainder was mud carried down by the Michigan River.

Thickness, facies, and crossbedding...indicate the existence of a regional slope to the southwest, perpendicular to the prevailing north 65° west trend of the shorelines. The Illinois Basin, although developing structurally during this time, was not an embayment of the interior sea. Indeed, the mouth of the Michigan River generally extended out into the sea as a bird-foot delta, and the shoreline across the basin area may have been convex more often than concave.

....The shoreline was not static. Its position oscillated through a range of perhaps 600 to 1000 or more miles. At times it was so far south that land conditions existed throughout the present area of the Illinois Basin. At other times it was so far north that there is no suggestion of near-shore environment in the sediments still preserved. This migration of the shoreline and of the accompanying sedimentation belts determined the composition and position of Genevievian and Chesterian rock bodies.

Lateral shifts in the course of the Michigan River also influenced the placement of the rock bodies. At times the river brought its load of sediment to the eastern edge of the basin, at times to the center, and at times to the western edge. This lateral shifting occurred within a range of about 200 miles. The Cincinnati and Ozark areas did not themselves provide sediments, but, rather, the Michigan River tended to avoid those relatively positive areas in favor of the down-warped basin axis

Sedimentation belts during this time were not symmetrical with respect to the mouth of the Michigan River. They were distorted by the position of the river relative to the Ozark and Cincinnati shoal areas, but of greater importance was sea current or drift to the northwest. This carried off most of the mud contributed by the river, narrowing the shale belt east of the river mouth and broadening it west of the mouth. Facies and isopach maps of individual units show several times as much shale west of the locus of sand deposition as east of it. The facies maps of the entire Chesterian...show maximum sandstone deposition in a northeast-southwest



belt that bisects the basin. The total thickness of limestone is greatest along the southern border of the basin and is relatively constant along that entire border. The proportion of limestone, however, is much higher at the eastern end than along the rest of the southern border, because little mud was carried southeastward against the prevailing sea current. Instead, the mud was carried to the northwest and the highest proportion of shale is found in the northwestern part of the basin.

Genevievian and Chesterian seas generally extended from the Illinois Basin eastward across the Cincinnati Shoal area and the Appalachian Basin. Little terrigenous sediment reached the Cincinnati Shoal area from either the west or the east, and the section consists of thin limestone units representing all or most of the major cycles. The proportion of inorganically precipitated limestone is relatively high and the waters over the shoal area were commonly hypersaline... Erosion of the shoal area at times is indicated by the presence of conodonts eroded from the St. Louis Limestone and redeposited in the lower part of the Gasper Limestone at the southeast corner of the Illinois Basin...

The shoal area included regions somewhat east of the present Cincinnati axis and extended from Ohio, and probably southeastern Indiana, through central and east-central Kentucky and Tennessee into Alabama....

Toward the west, the seaway was commonly continuous between the Illinois Basin and central Iowa, although only the record of Genevievian and earliest Chesterian is still preserved. The seas generally extended from the Illinois and Black Warrior regions into the Arkansas Valley region, and the presence of Chesterian outliers high in the Ozarks indicates that at times the Ozark area was covered. Although the sea was continuous into the Ouachita region, detailed correlation of the Illinois sediments with the geosynclinal deposits of this area is difficult.

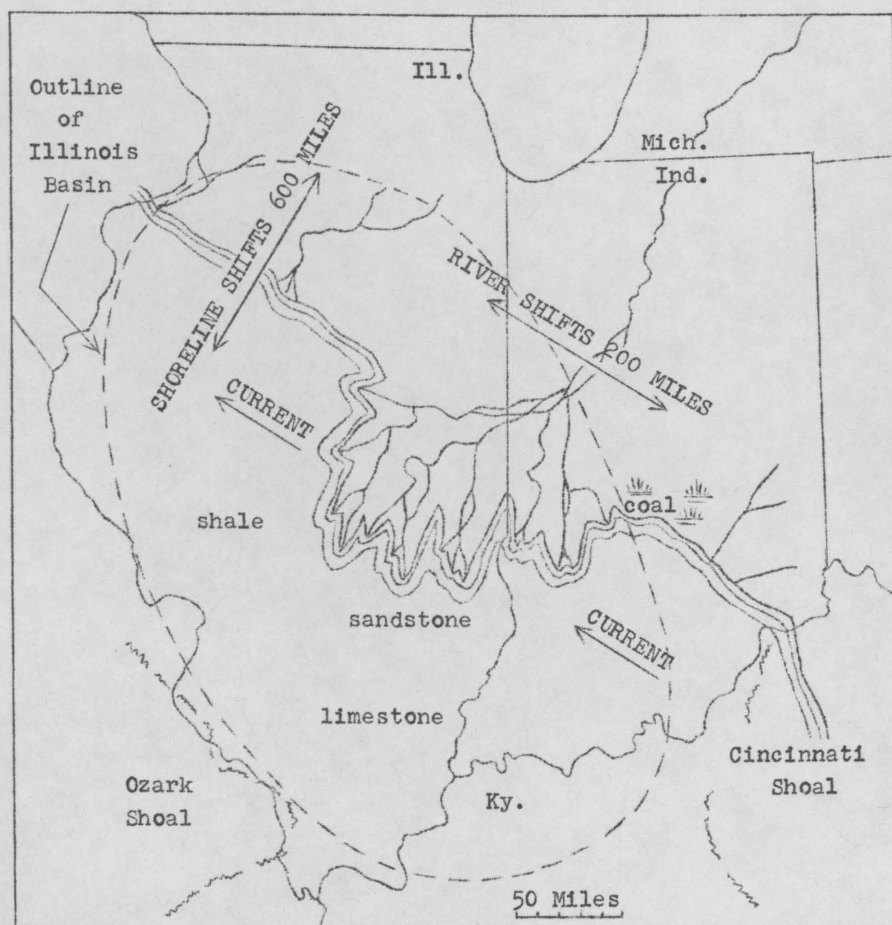


Fig. 4 - Paleogeography at an intermediate stage during Chesterian sedimentation.

THE CHESTERIAN SERIES IN RANDOLPH COUNTY  
REPRESENTED BY  
A COMPOSITE COLUMN AND AN ELECTRIC LOG

The composite column on the next page (taken from Plate 1, Report of Investigations 216) is a diagram drawn to represent certain rock beds as they appear in a small region--the district around the town of Chester, 20 miles south of Red Bud. The electric log is a record made from instrument observations of rock beds in a very small locality--the bore of an oil-test well 8 miles east of Red Bud. A geologist made the column, using symbols to briefly express the significant rock unit qualities he could observe. In contrast, the e-log was made by an electrical sensing device lowered and raised in the test well to measure only two specific qualities of the rock layers: spontaneous-potential and resistivity. Together, the correlated column and e-log show in a concise way what the isolated outcrops on the field trip itinerary cannot: that is, what thicknesses, variations in lithology, and mutual relations the sub-divisions of the Chesterian Series have across the county. In addition, the correlated e-log is a key that may be used to interpret other e-logs in this part of the Illinois Basin.

The e-log and column, correlated and reproduced at the same scale, also demonstrate these points: (1) thicker layers of sandstone or shale or limestone--a particular rock unit--are delineated as characteristic shapes by the pair of S-P and resistivity curves, (2) the units of the Chesterian Series vary in thickness and composition from one place to another, but many points of similarity persist (the unique curves of some units persist for several hundred miles), and (3) the seemingly abstract curves of the e-log create a picture in many ways as readable as other illustrations of rock columns.

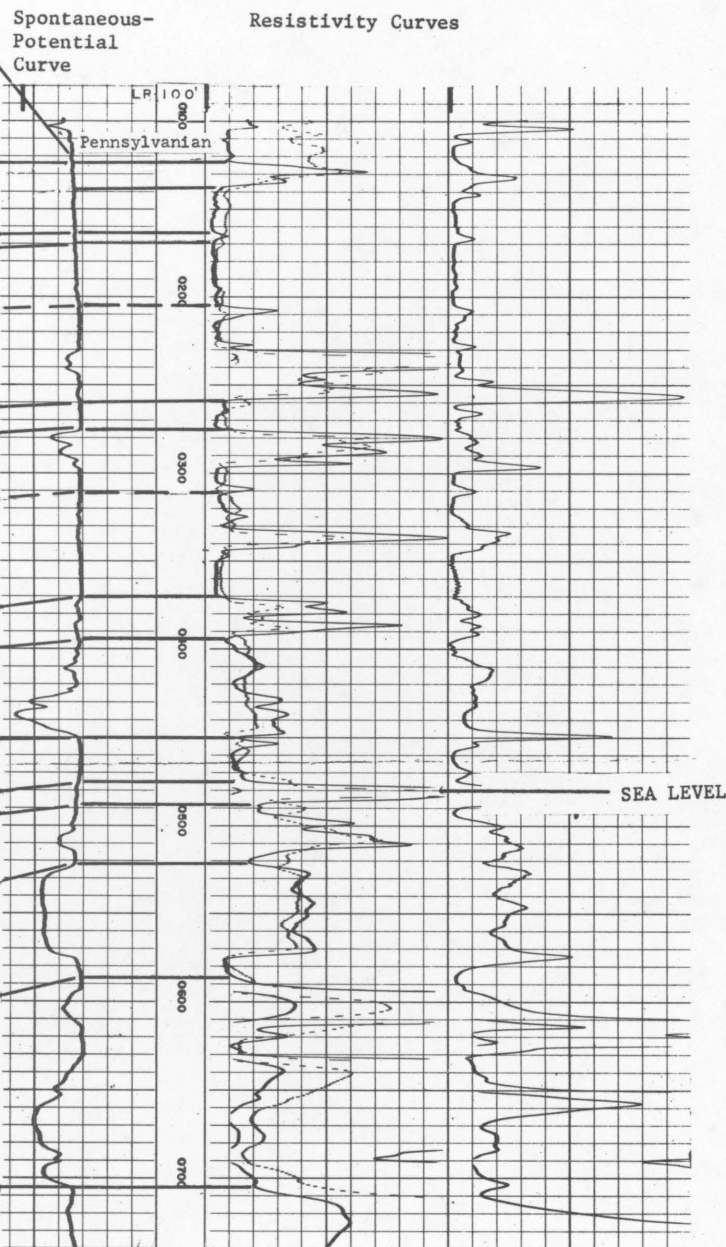
Since Illinois has been a major oil producer for many years, tens of thousands of e-logs have been made of wells drilled in the state. They are the principal tool of the geologists who map deep subsurface geological units and structures. Because of their value, e-logs and other types of well logs are filed as permanent records at the Illinois State Geological Survey, where they may be examined. (Copies of electric logs can be purchased from companies that reproduce them.)

**PENNSYLVANIAN**

OTHER NAMES	STAGE	THICKNESS (feet)	DESCRIPTION / STRATIGRAPHIC POSITION
Cove Hill	KINKAID	~10	Topmost stage, thin bedded.
Negli Creek	DEGONIA	~10	Below Kinkaid, contains red beds.
Ford Station	CLORE	~10	Below Degonia, contains red beds.
Tygett	PALESTINE	~10	Below Clore, contains red beds.
Cora	MENARD	~10	Below Palestine, contains red beds.
Allard	WALTERSBURG	~10	Below Menard, contains red beds.
Scottsburg	VIENNA	~10	Below Waltersburg, contains red beds.
Walche	TAR SPRINGS	~10	Below Vienna, contains red beds.
Glen Dean	HOMBERGIAN STAGE GROUP	~10	Below Tar Springs, contains red beds.
Hardinsburg	OKAW	~10	Below Glen Dean, contains red beds.
Haney	OKAW	~10	Below Hardinsburg, contains red beds.
Fraileys	OKAW	~10	Below Haney, contains red beds.
Beech Creek	OKAW	~10	Below Fraileys, contains red beds.
Cypress	RUMI	~10	Below Beech Creek, contains red beds.
Ridenhower	GASPERIAN STAGE	~10	Below Cypress, contains red beds.
Bethel	GASPERIAN STAGE	~10	Below Ridenhower, contains red beds.
Downeys Bl.	GASPERIAN STAGE	~10	Below Bethel, contains red beds.
Yankeeetown	GASPERIAN STAGE	~10	Below Downeys Bl., contains red beds.
Renault	GASPERIAN STAGE	~10	Below Yankeeetown, contains red beds.
Aux Vases	GENEVIEVIAN STAGE	~10	Below Renault, contains red beds.
Ste. Genevieve	GENEVIEVIAN STAGE	~10	Bottommost stage, contains red beds.

**ST. LOUIS**

WELL: GUIEBERT #2  
LOCATION: SW NW SE 7-4S-6W  
COUNTY: RANDOLPH  
ELEVATION: 480' ground level



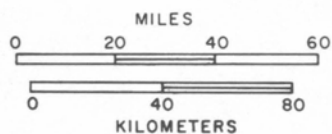


## Reprinted 1970



GEOLOGIC MAP OF ILLINOIS  
showing  
BEDROCK BELOW  
THE GLACIAL DRIFT  
1970

(From Willman and Frye, 1970.)



Pleistocene and  
Pliocene not shown



TERTIARY



CRETACEOUS



PENNSYLVANIAN

Bond and Mattoon Formations  
Includes narrow belts of  
older formations along  
La Salle Anticline



PENNSYLVANIAN

Carbondale and Modesto Formations



PENNSYLVANIAN

Caseyville, Abbott, and Spoon  
Formations



MISSISSIPPIAN

Includes Devonian in  
Hardin County



DEVONIAN

Includes Silurian in Douglas,  
Champaign, and western  
Rock Island Counties



SILURIAN

Includes Ordovician and Devonian in Calhoun,  
Greene, and Jersey Counties



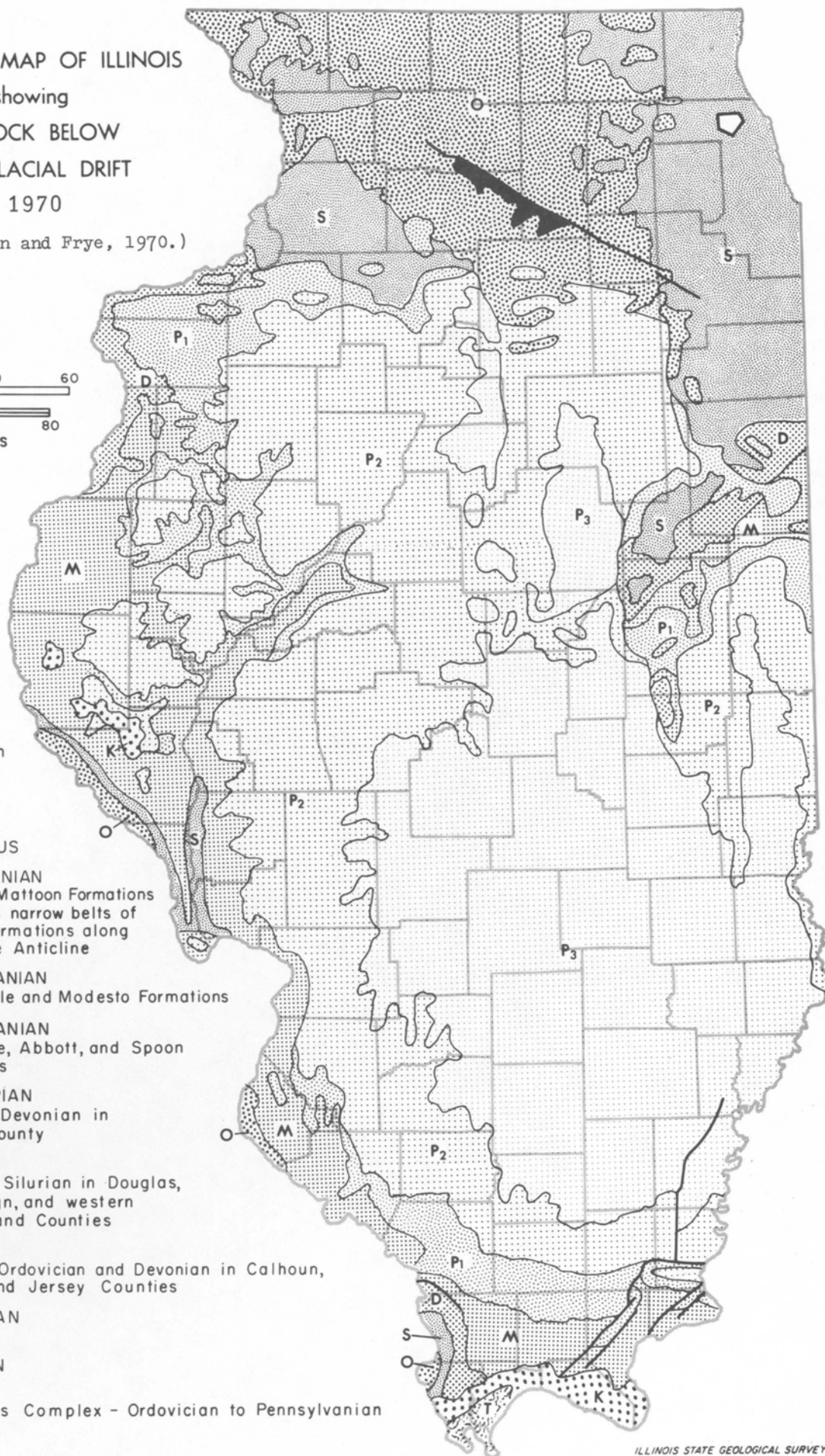
ORDOVICIAN



CAMBRIAN



Des Plaines Complex - Ordovician to Pennsylvanian  
Fault



BRYOZOANS



*Rhombopora* 1x



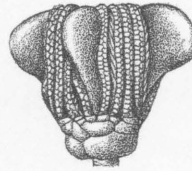
*Archimedes* 1x

TRILOBITE



*Phillipsia* 1x

GRINIDS

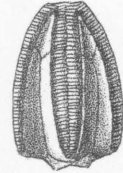


*Pterotocrinus* 1x

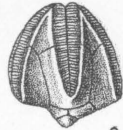


*Platytrichus* 1x

BLASTOIDS



*Pentremites* 2x

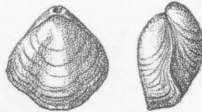


*Pentremites* 2/3x

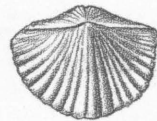
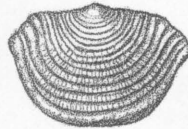
BRACHIOPODS



*Composita* 1x



*Leptaena* 1x



*Spirifer* 1x



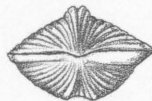
*Spiriferina* 1x



*Triplophyllites* 1x



*Brachythyris* 1x



*Pugnoides* 1x



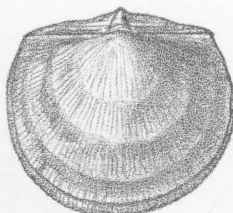
*Girtyella* 1x



*Caninia* 2/3x



*Orthotetes* 1x



*Schuchertella* 1x



*Echinoconchus* 1x





